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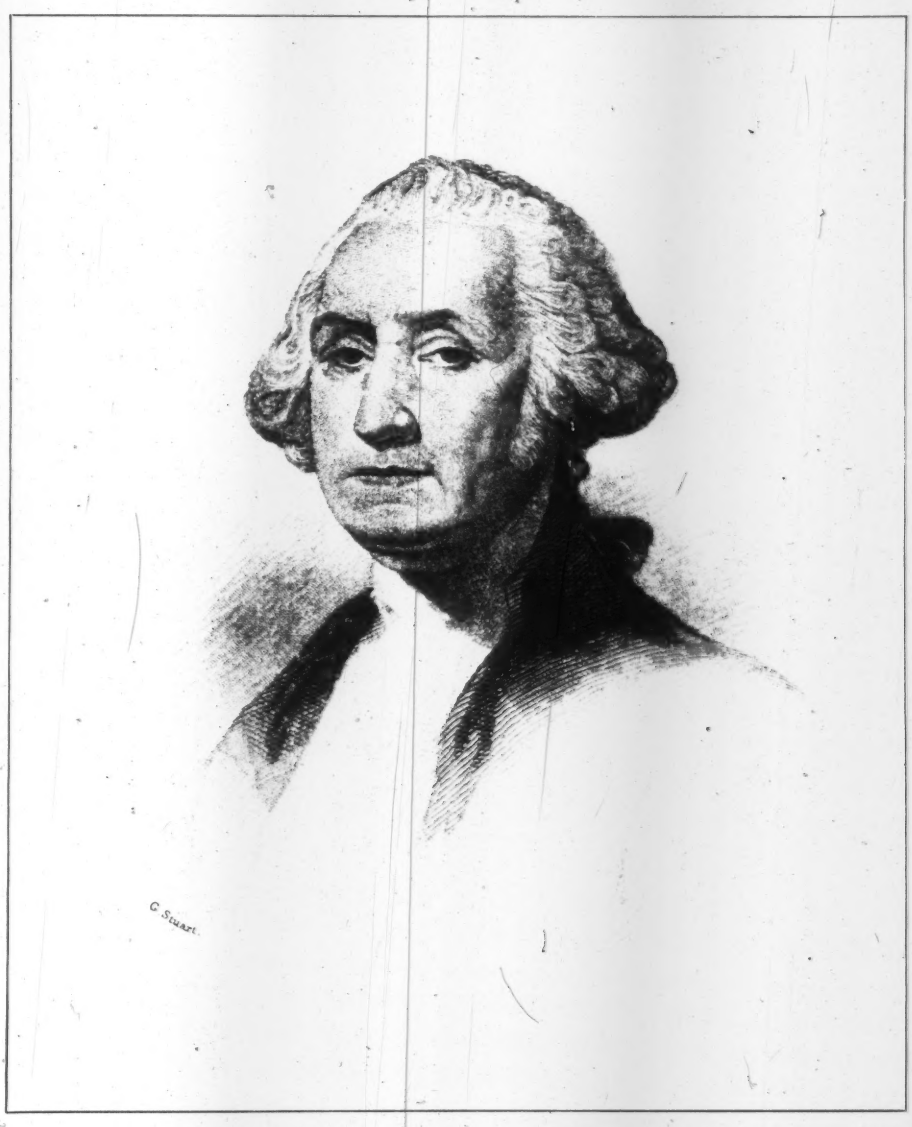

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G. Washington

A land surveyor at the age of sixteen Washington was one of the pioneers in what has now become the profession of civil engineering. His knowledge of topography gained in early manhood led him later to project the route of one of our first inland waterways

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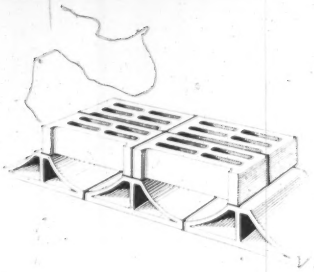

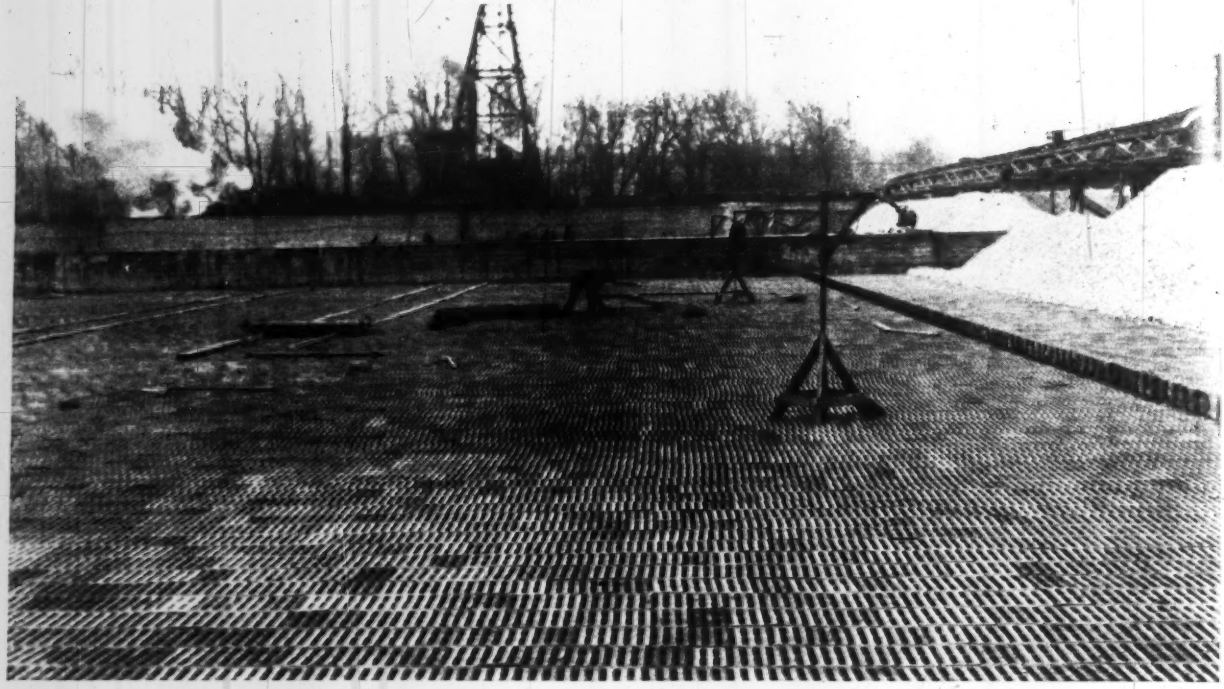

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B. O. D. not only requires sufficient voids in the filter medium, but these voids must be matched by enough ventilating ducts or pores in the filter floor to allow free passage of atmospheric oxygen. It is only by this means that the filter's primary purpose of purification is accomplished. Hence it is the filter floor that supplies the filter with adequate breathing capacity.

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Engineering News-Record

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F. E. Schmitt, Editor

Volume 108 — New York, February 18, 1932 — Number 7

Backbone and Sense

DOMINATING all the sensational events of the day, the shutting off of municipal credit as yet shows no signs of reversing its trend. City bonds, short-term notes and tax warrants are equally without market. Said a prominent banker a few days ago when offered a small city bond issue, "All municipal securities are sour"; and he declined the offer, thereby stopping an essential revenue-earning improvement.

Construction is stopping, essential services have been curtailed, and able organizations are being dispersed. Fully a third of the country's construction budget is in jeopardy, with effects that can hardly even be foreseen. So rapidly is unfavorable sentiment on municipal soundness growing as to create a danger that even early improvement in the bond market may find the cities unable to utilize it.

Are any remedies at hand that can be applied to the situation?

Backbone is one remedy. As custodians of the public's interest, city officials have the primary obligation of defending and upholding the community services and opposing attempts to restrict them. They know the essential character of these services; they know how imperative is the maintenance of their operating programs especially in times of depression, and how closely their construction work is related to amelioration of unemployment. They may concede the desirability of economizing, but they can insist that economy at the cost of increased unemployment and ruined municipal services is unacceptable.

Such defense of the city's position may not always prove convincing to those who control the money, but it will go far toward combating the belief in financial circles that there is merit in bearing down on city credit. Moreover, negotiations carried on in the full light of public knowledge, as every public interest requires, would maintain a healthy and constructive attitude of the citizenry toward the difficulties under which cities are laboring.

That the financial problem of funding city requirements is not hopeless may be seen in the fact that existing laws authorize the purchase of tax warrants by the Federal Reserve banks. These provisions of the law clearly show that our banking system has an essential function to fulfill toward municipal financing.

Up to the present, however, city bonds have had no discount market, and banks have been seriously short of funds, as everyone knows. Now, with the powerful support of the Reconstruction Finance Corporation and its ability to loan on municipal securities, and the still greater support of the Reserve Credit liberalization about to be enacted, they are provided with funds in ample volume to supply the country's credit needs, municipal as well as industrial. This is the second remedy for the present critical condition, for it is now up to the bankers to turn credit to the cities sufficient for their needs. No obstacle lies in the way other than their own good sense and understanding.

The events of the near future should show whether the credit-relief measures are effective in this respect. The issue depends both on the power of the measures themselves and on the wisdom with which bankers apply them. If they fail in relieving the plight of the cities, for whatever cause, the hopes now entertained for a steady rise from depression will be dashed, and the present measures will go the way of their predecessors. There will be no recourse then but direct aid to the cities by the national government, and that aid given quickly.

MORE HELP IS NEEDED by the voluntary agencies which have been attempting to relieve hardships due to engineering unemployment. Wholesale discharges of engineers since the first of the year have greatly increased their burden. This is especially true in the New York metropolitan district, where the Professional Engineers Committee on Unemployment is doing a remarkable job.

This appeal is directed especially to the men who have not been reached by appeals sent to members of the engineering societies sponsoring the work of relief committees, and also to those members who have not responded to the appeal. Relief is being given without regard to society membership; more than half the men placed in jobs by the New York committee are non-members. Support of the work must be on the same basis. Ten per cent of the membership of the engineering societies have borne the brunt of the load so far. The help of every engineer in a job is needed.

If you live in the New York metropolitan district, send your contribution or pledge for a monthly subscription to the Professional Engineers Committee on Unemployment, 33 West 39th St., New York City. Elsewhere send it to your local committee. The weeks from now to spring are going to be critical ones in relief work. See that the work does not lag or fail for lack of *your support!*

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NOTES OF THE WEEK

Much Work Waiting

NEARLY a billion dollars of public construction is held up by inability of cities to sell bonds, so the Washington estimate cited by Joseph Jacobs (p. 262) indicates. It is probably a conservative figure. Converting this money estimate into employment, it is seen to mean work for at least half a million men, a significant fraction of the roll of unemployed. Evidently the work now ready and authorized would, if the money were found, produce a decided increase in our economic well-being through the purchasing power it would release into the stream of trade and manufacture; revival from depression would be surer and earlier. Correspondingly the paralysis of this volume of construction retards the cure. The Washington figures fully bear out the opinion that public-works increase to stem the tide of confidence deflation is feasible without seeking for new and unexplored projects. Pent-up needs for improvement work are waiting in such volume that they can at a moment's notice be utilized for the general benefit.

Newborn Confidence

SOME of the financial shackles that have fettered the country have been loosed by the credit-broadening laws passed by Congress in the past week. Already the first loans have been made by the Reconstruction Finance Corporation, one or two of them to railways. The stimulating effect of these operations and the prospective liberalization of Reserve System practices by the Glass-Steagall bill was not slow to appear in a wave of buying confidence in staple commodities as well as securities late last week, which greatly changed the balance-sheet of our economic establishment for the better. Will it improve manufacture and trade? The answer remains in doubt so long as present threats to stop construction activities continue. Pumping credit into the top of our system, however essential to stop the disintegration of values and solvencies, cannot alone make business. Business activity depends on the buying masses, which just now are the unemployed masses. Neither factory nor railroad can expect much new business until men are again at work and have wages with which to buy. The merit of the employment movement recently started is that it attacks this end of the problem—if it works. A decided increase in wage payments, coupled with the resolute freeing of credit that is in progress, can make new business activity, provided the improvement is not counteracted by curtailment of construction.

Wage Rate Agreements

LABOR relations always are better during a period of depression than in prosperity. It is well to bear this in mind in appraising recent agreements setting lower wage rates, both outside and within the building field. Nevertheless it is impossible to conclude that these agreements are not significant in marking a new advance between labor and industry. Outstanding among them is that between the four railroad brotherhoods and the railroad executives providing for a ten per cent decrease in railroad pay. Never before have labor representatives gone so far in acknowledging labor's responsibilities in keeping industry solvent, or employers gone so far in conceding their obligation to the worker. The same spirit may be seen in the recent downward adjustment of building labor rates in Portland, Ore., where a board representing builders, general public and labor lowered the wage scale about 20 per cent with the consent of both sides. In Chicago also a downward revision of 20 per cent has been agreed upon. All these happenings bear witness to a new spirit of cooperation. Its survival and progress promise further advance in human relations.

Hot Cement

THE belief that hot cement has some detrimental effect on concrete quality is old. A decade ago it was solemnly spoken of as a danger in using heated materials for winter concreting. More recently occasional cautious highway builders have been writing specifications which limit the temperature of the cement to 125 deg. F. During the last year research has been taking a hand in the question, and as described at some length in this issue the results show small justification for any concern about cement temperatures likely to be encountered in normal roadbuilding operations. In brief, neither the testing machine nor the concrete worker, nor the engineer's inspector, could discover any material difference between the action of cement at temperatures approaching 180 deg. and of cement at normal temperatures of half this intensity. While the results given are those of only one of the investigations being conducted by the committee of the American Society for Testing Materials, they are so positive that action to place a cement-temperature limit in pavement specifications can well be postponed until final conclusions are arrived at by the committee.

Vindicating Judgment

IN USING the principal engineering materials, steel and reinforced concrete, engineers have relied heavily on laboratory test results and experience with structures in service. Confidence of this kind has not been misplaced, even though service records are necessarily limited. Neither steel nor concrete has been in use long enough to determine accurately its life span, nor indeed to permit a proper evaluation of its rate of deterioration. Gradually, however, as early structures are being examined for repair or are demolished to make way for more modern facilities, valuable service data are being accumulated. In general, they vindicate completely the confidence placed in the behavior of these materials. Examination recently of the Tunkhannock viaduct showed the concrete to be in thoroughly sound condition after seventeen years. Demolition of the Waldorf-Astoria Hotel in New York revealed 40-year-old steelwork practically unaffected by time. And now in Chicago steel beams of 1884 vintage, the first used in building work in this country, have been removed from the Home Insurance Building and show no signs of deterioration. Steel from the Tacoma Building, also in Chicago, and co-claimant with the Home Insurance Building for the title of the first skyscraper, was found to be similarly unaffected when the building was razed several years ago. The service life of steel in buildings is thus more than half a century. Since the deterioration during that time was negligible, the life of properly designed and incased steel in buildings may be assumed to be indefinite. Also, if these past experiences are criteria, the end point of this service life is indefinitely beyond the economic life.

City Services and Construction in Danger

WITH amazing suddenness, growing municipal costs and debts and the burden of taxation have been thrust into the forefront of discussion, and a movement has developed that threatens to paralyze community services and throttle public-works construction. This movement has intensified unemployment and aroused widespread fear of still more unemployment. The campaign to slash governmental budgets and reduce taxes, originated by real-estate interests, has been taken up by representatives of industry and trade. It is time for all to face the situation.

The president of a large steel company said recently: "The tax burden is a very serious and prominent item in cost sheets [of industries] today. The country is rapidly approaching, if it has not already reached, the danger line of financial stability because of the delirious extravaganza of federal, state and municipal spending . . . Reduce the tax bill . . . Taxes will be reduced when the people as a whole are made to realize they are paying for extravagant government administration."

Still more recently, a group of New York industrial and business men in a resolution demanding tax reduction says: "The first need today is to revive private industry . . . Public spending on the present scale cannot continue without prolonging the present depression . . . The policy of the state has been to permit the undue spending of public money in the 11,000 cities, counties, towns and villages and school districts of the state." And on the basis of this preamble the group urges budget and tax reduction, personnel and salary decreases, and the postponement of capital expenditures.

Ever since the current depression began, nothing more dangerous than this demand for "postponement of capital expenditures" has been voiced. For two years the united call has been for public works and for municipal relief operations to combat unemployment and distress. Now, at the most critical time, construction is being stopped, the cities' everyday operations are checked, and the number of unemployed is increased.

Yet these are merely typical symptoms of the wave of hysteria passing over the country regarding governmental costs. The general press echoes such views, and implies that governmental activity is extravagant, largely unnecessary, suffused with predatory interest and dangerous to the economic well-being of the country. Tax bills are looked upon as pure tribute. The widely publicized financial embarrassment of some of our major cities has lent color to this point of view.

To approach the problem rationally it is essential to keep in mind that city government is a cooperative enterprise which provides at cost the services demanded of it. There was a time, long since past, when government was confined in its activities to the maintenance of law and order, the protection of life and property. With the rapid development of urban civilization, community enterprises of a different order were found desirable to assure an educated citizenry, to protect health, and to facilitate public transportation. Today the greater part of the money collected in taxes is spent on these services, of which we have long been justly proud and which have been brought to their present degree of usefulness by long years of conscientious effort.

And these services in truth make the growth of cities possible and tolerable. No one seriously considers discontinuing the numerous community enterprises that make a city livable in 1932. The benefits we have all derived from them are too great for us ever to forego them willingly in the future. The money we have spent on highways and streets has been to the profit even of the very industrialists who object so forcibly to the increase of public expenditure.

Indeed we have been niggardly toward institutions. Schools, hospitals, libraries, social service departments and the like are, by and large, sadly understaffed. Many cities have been forced, not by their own desire for "extravagant administration" but by administrative or judicial decree, to treat their sewage so as to bring to an end the pollution of neighboring waters. As years go by, and our urban centers grow in size and our civilization in complexity, more and more facilities will be needed that can be supplied only by community enterprise. The cost will be the price of living in a city.

It has been implied, though no proof has ever been offered, that the cost of supplying these services is unjustifiably high, that governments are extravagant and that the economy of administration would suffer greatly by comparison with an efficient business organization. Such charges are difficult either to prove or to refute because of the fundamental difference in orientation between business and government and because of lack of comparable data. No doubt all governments, and also all industries and businesses, could be improved in efficiency and economy. If the present clamor for reduced expenses can help to bring about such improvement it will be of great service. But hysterical moves to decrease costs, carried on blindly, will undoubtedly harm most the services of greatest importance to humanity and industry. Such a program is likely to cause in a short time injuries to our urban development from which it will take many long years to recover.

Unfortunately the common attitude is to consider government at its political rather than at its operating level. For every dishonest or needless political retainer upon the public payroll there are numerous conscientious public servants, capably performing at small salaries the technical duties for which they have been trained. These, however, are usually the first to feel the effects of injudicious moves toward economy, as are the vital services they administer. The dangers inherent in the situation are so great that curtailment of expenses must be carried out with great care if serious damage to our cities' development is to be avoided.

In view of these critical dangers to our urban development, *Engineering News-Record* has undertaken to do its part in helping toward straight thinking by presenting a balanced statement of facts. Accordingly, a series of articles has been developed, the first of which is to appear next week, which will discuss the services rendered by municipalities and the costs involved. The purpose of the series is twofold: *First*, to remove misconceptions as to governmental wastes and extravagance: *second*, to direct the existing forces into channels where they can do the most permanent good in the way of eliminating inefficiencies. Undirected, those forces are endangering our urban civilization itself.

George Washington —Engineer

A review of the record of George Washington's early experience as a land surveyor and of those features of his career that relate to engineering subjects—Appreciation of the fundamentals upon which all sound engineering is built revealed in his observations and comment upon the transportation problems of his day

CELEBRATION of the 200th anniversary of the birth of George Washington begins next week. For the average citizen of this country interest in his life centers chiefly in his contributions to the upbuilding of the nation. But for engineers among our citizens interest centers in those parts of his life training and experience that often cause him to be characterized as a civil engineer.

His qualities and attainments

Measured by the standards of today, Washington hardly can be classed as a civil engineer. His professional attainments ranked with those of a land surveyor. But going beyond superficial examination of his accomplishments, examining the records of his earlier years and his revelation of himself in his notes and diaries, especially in the knowledge that the engineering arts as we know them hardly existed in Washington's day, the student of his life comes to realize that his were engineering attributes.

Skillful in mathematics, apt with tools and fond of putting his observations to a practical test, a keen observer, logical in his reasoning, and above all practical, he doubtless would stand at the forefront of the engineering profession today. In his day its scope was limited chiefly to land surveying, a practice that he mastered before he was sixteen years old and in which he rapidly advanced to that position of leadership occupied by the modern chief-of-part but his natural ability as a leader a executive rapidly pushed him beyond the narrow limits of the field of land surveying.

Land surveying was a lucrative and genteel calling in Washington's day, and so it was natural that he, having limited means in his youth, should have turned to it when compelled to give up his first plan of going to sea. The sea venture was planned as young Washington, a boy of fourteen, was completing his studies in a private school. Details had been arranged, even to a ship, when his widowed mother decided she could not let him go. Returning to school, young Washington concentrated on land surveying, geometry and trigonometry, and in his spare time amused himself surveying and making maps of fields at Mount Vernon, the estate of his half-brother Lawrence Washington, son-in-law of the Hon. William Fairfax.

Early surveying in Virginia

In March, 1748, when not yet sixteen, young Washington set out in company with George Fairfax, son of the Hon. William Fairfax and grandson of Lord Fairfax, and a party of surveyors to go beyond the Blue Ridge Mountains into the Shenandoah Valley to survey land for settlers, who then were rapidly taking up part of Lord Fairfax's vast holding in the "Northern Neck" of Virginia. Lord Fairfax held title to nearly six million acres in what is now the northern part of Virginia and in West Virginia, and he and his son con- tly employed surveyors to stake out ds taken over by settlers.

WASHINGTON'S OUTLINE OF A TRADE ROUTE FROM DETROIT TO ALEXANDRIA, VA., WITH ESTIMATES OF DISTANCES.

	Miles
Detroit to Cuyahoga River....	125
Up the same to the portage...	60
Portage to Beaver Creek.....	8
Down Beaver Creek to the Ohio	85
Up the Ohio to Fort Pitt.....	25
To mouth of Youghiogheny....	15
Falls to ditto.....	50
Portage	1
Three Forks to Turkey Foot..	8
Fort Cumberland to Wills Creek	30
Alexandria	200
	607

One of the prime human-interest touches in the historical record comes to light in the report that during this first excursion into new country, Washington had an experience that many a young engineer in later years shared. The party's lodging the first night was not of the best, and young George—lacking, as he states in his diary, the experience of his fellows—stripped off and got into the bed only to find it full of vermin. When the lights were taken away, he states, he redressed and lay on the top of bed as did his more experienced fellows. After that the party slept in the open in tents, preferring the latter form of shelter even when other means was available.

Another entry casting light upon the crude conditions under which much o the work of that first surveying exp dition was carried on is one in whic Washington states that they had knive to eat with but used forked sticks fo spits upon which to cook their mea and wood chips for plates.

One of the party on this first sur veying expedition was James Genn, "a licensed surveyor of Virginia," and i appears that Genn and the chainmen and "markers" did much of the actual field work, leaving the matter of deal ing with the tenant farmers to Fairfax and Washington. This conclusion is drawn from the fact that Washington noted in his diary the few pieces of land he surveyed himself, and they are not numerous. But later, referring to the records of Culpeper courthouse, it appears that on July 20, 1749, "George Washington, Gent., produced a commission from the President and Master of William and Mary College appointing him a surveyor of this county, which was read, and thereafter he took the usual oaths." Subsequent records refer to Washington as a "licensed surveyor" and those of his survey notes which relate to surveys in Culpeper County are signed "George Washington, S.C.C." (Surveyor Culpeper Co.).

Warrants for land surveys listed in among Washington's notes in 1750 total 6,500 acres, mostly in small farm lots.

In one account Washington says that he was paid a doubloon ($8.20) a day on days that they worked and sometimes as much as six pistols ($21.60), but it is not clear whether this was his own pay or the pay for himself and his chainmen and markers. His notes of that period are full of notes of extensive surveys, including some neatly drawn sketches. Of his work J. M. Toner, in publishing his diaries, states that his surveys are among the few made in pre-Revolutionary days not since disturbed by court decisions.

Westward explorations

Washington's career as a land surveyor came to a close with his departure in 1751 to the Barbadoes with his half-brother, Lawrence Washington, on account of the latter's health. Upon their return he succeeded his brother as adjutant-inspector of the militia of Virginia. This was the beginning of his military career and his active public life. It was the beginning also of his extensive travels into the little-known country west of the Alleghanies, first in 1753, to the French forts near Lake Erie as an envoy of the British governor of Virginia and later in the French and Indian wars. Meanwhile his brother had died and he succeeded to Mount Vernon and considerable property. Of what might be termed Washington's engineering activities in this period there is little record. As a colonel in the Virginia militia he visited and roughly located

the frontier forts; whether he laid out or directed the construction of any of them is not clear.

In his trips to the West, Washington was greatly impressed with the fertility of the Ohio Valley and with the need for better communication with the Atlantic seaboard. In 1759, following his return from the trip to capture Fort Duquesne, he proposed to the Virginia House of Burgesses that the Potomac be improved to provide a connection with the Ohio, and he pressed the proposal as opportunity presented. Finally, in 1774, bills were brought before the Virginia and Maryland assemblies for the improvement of the Potomac, but nothing was accomplished before the Revolution put an end to all such planning.

Planning public works

The pre-Revolutionary period is marked by another project of special engineering interest, which further prepared for his later planning of public improvements. In 1763 Col. Washington, then living in retirement on his estate at Mount Vernon, organized a company to drain and develop the Dismal Swamp. During the next five years he appears to have devoted considerable time to the project, and doubtless he was the engineering executive who laid out such work as was carried forward before the Revolution broke out.

Again while at West int during the Revolutionary period he found time to satisfy his curiosity as to the possibilities of the Mohawk route to the West. For this purpose he went up to Albany and out the Mohawk Valley and over the divide to Lake Oneida, spending three weeks in such reconnaissance work and in visiting local defense works.

Trade routes to the West

At the close of the Revolution Washington returned to Mount Vernon and at once became active in promoting the opening of better communication to the West. His writings of that time show how clearly he saw that if the settlers west of the Alleghanies were not bound to the East by convenient artificial trade routes their trade and allegiance would follow the natural trade routes, either south down the Ohio and Mississippi to the Spanish settlements in the vicinity of New Orleans or north to the British and French in the Great Lakes region and along the St. Lawrence River Valley.

In 1784 Washington set out once more for the Ohio Valley. Of this trip he says: "One object of my journey being to obtain information of the nearest and best communication between the Eastern and Western waters; & to facilitate as much as in

George Washington, from a portrait painted by Charles W. Peale in 1772 and now owned by Washington and Lee University. It shows Washington in the uniform of the provincial troops, the dress he wore during a considerable part of the pre-Revolutionary period when he was most actively engaged in enterprises of an engineering nature.

me lay the Inland Navigation of the Potomack." At that time he arranged for actual surveys of possible portage routes between the probable headwaters navigation on opposite sides of the mountains. From physical considerations alone he favored communication by way of the Youghiogheny River to the Ohio, but because of political considerations involved in diverting the western Pennsylvania traffic out of the state he was forced to consider also a route lying wholly within the Virginia territories.

Upon his return to Virginia in October Washington reported to Governor Harrison upon several trade routes from Detroit (which he considered the key point of the Lake region) to Alexandria. The best route, he stated, was by way of the Cuyahoga, Beaver Creek, the Ohio, Youghiogheny and Potomac. This he estimated at 607 miles. An alternate route he set at 663 and a third, avoiding Pennsylvania, at 799. He also estimated distances, Detroit to Richmond, 840 miles; to Philadelphia, 741 miles; to Albany, 943 miles; to New York, 1,103; and to Montreal, 775 miles. Washington stated that these estimates doubtless were inaccurate, as he had only crude maps to work with. Accurate surveys, he told Governor Harrison, were highly desirable.

Canal undertakings

In December of that year Washington was elected president of the Potomac Company, an organization empowered to make the Potomac navigable in dry seasons for vessels of 1-ft. draft to a point on the North Branch, "where a road shall set forth to the Cheat River"; also to collect tolls for the movement of traffic. He also headed a similar company organized, apparently for political considerations, to develop the James River. As things turned out the latter company developed considerable local traffic and met with some success. The Potomac Company did some development work, but failed in 1822. Out of its ashes rose the Chesapeake & Ohio Canal Company. Washington's official connection with these companies ended when he became President of the Union in 1789.

Briefly, these are the events and developments that serve to mark Washington's relations to the engineering profession. Evidence of technical skill beyond that required for surveying and the preparation of maps is lacking, but there is ample evidence of other essential engineering attributes; of ability to distinguish between fact and assumptions, ability to observe correctly, and to make accurate deductions from facts and observations.

Washington's own words to Governor Harrison serve most adequately to exemplify his broad grasp of the fundamentals upon which sound engineering is built. In pleading for a careful survey of the routes to the West he urged that they be "accurately delineated, and a correct and connected map of the whole presented to the public." These things being done, he said, "I shall be mistaken if prejudice does not yield to fact, jealousy to candor, and, finally, if reason and nature, thus aided, do not dictate what is right and proper to be done."

First Major Low-Head Power Plant in the West—Rock Island

Columbia River dammed for the first time to develop 250,000 hp.—Propeller-type turbine runners with adjustable blades used on account of wide variations in head

By W. D. Shannon,
Stone & Webster Engineering Corp., Seattle, Wash.

THE first major power development on the Columbia River, built for the Puget Sound Power & Light Co., introduced into the West low-head construction equipment and procedure typical of several large Eastern projects. The ultimate 250,000-hp. installation will use 54,000 sec.-ft. of water at the maximum head of 51 ft. with floodflows reducing this head to about 20 ft. Construction occupied two low-flow seasons and the initial installation of four 21,000-hp. propellor-type waterwheels will be completed in 1932.

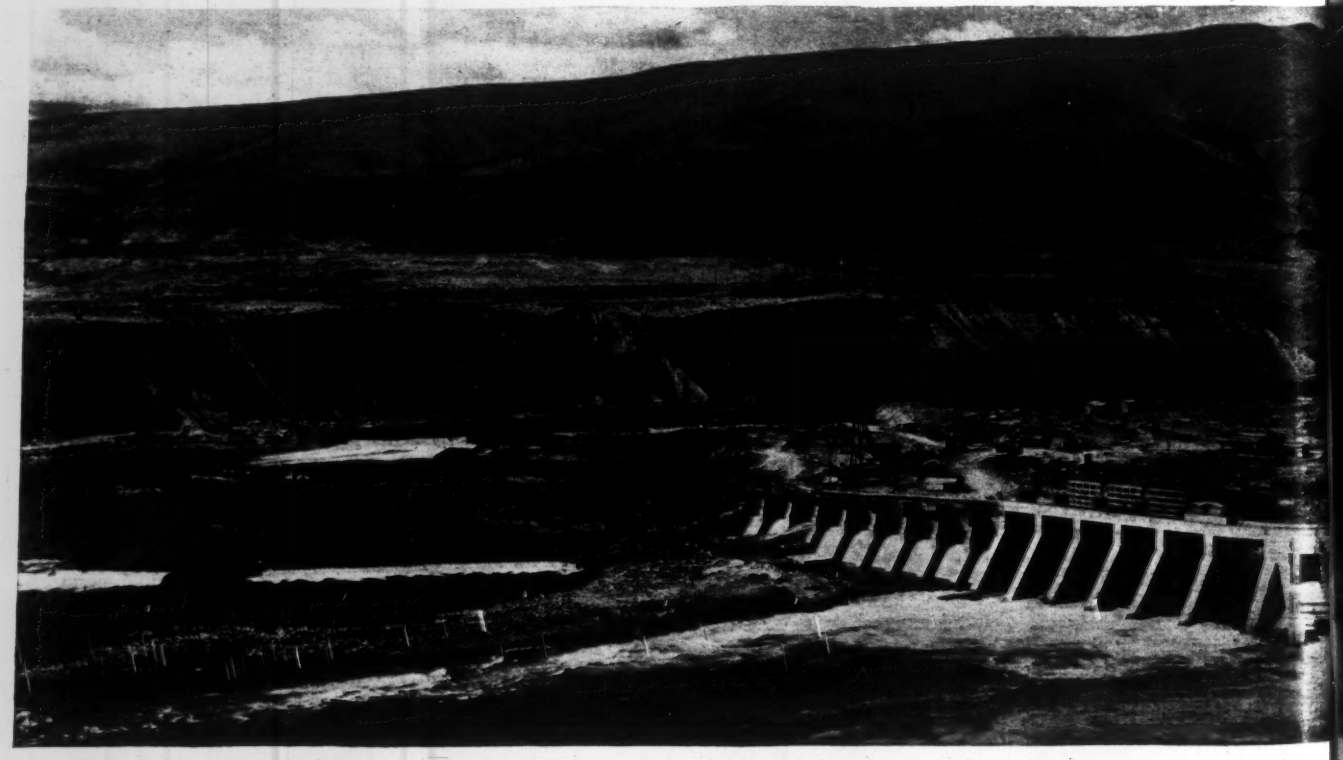
Project—The Rock Island development was initiated and programmed to provide the Puget Sound Power & Light Co. with an enlargement of central-station capacity that would permit gradual increase for a ten-year period. In 1927 a thorough study was made of the relations between the company's load and plant conditions. A three-year contract with another power company (1928-31) permitted an interval for programming and developing the additional power capacity. To establish better balance between hydro and steam capacity, the first part of the program consisted of the building of the Shuffleton steam station at Renton with an installed capacity of 70,000 kw. placed in operation in the spring of 1930.

During this time investigations of various hydro-electric power possibilities were being made and the Rock Island site on the Columbia River, about 13 miles below the city of Wenatchee, was studied. Based on soundings taken through the ice during the winter of 1928-29, topographic data were obtained for application for a preliminary permit to the Federal Power Commission in December, 1928. Following thorough investigation of the proposed development by the commission, a license was granted in January, 1930. Meantime the company's priority had been established and complete survey and investigations of the site were carried forward.

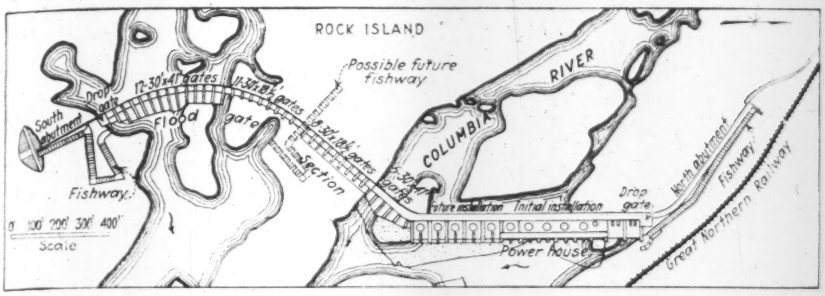
The site of the development receives its name from the large island dividing the river into an east and west channel and increasing the total distance between banks to a width of 2,700 ft. The geological formation is a lava flow estimated to be 1,000 ft. thick, which has been eroded by the river cutting channels into the softer portions of the rock. The island is a result of this erosion. Drill holes put down in this basaltic formation proved the lava rock to a depth of at least 125 ft. The rock is a crystalline formation, very hard, fine grained and extremely brittle. It is formed into hexagonal crystals varying from 12 to 36 in. across.

Hydrology

It is possible to sketch only very briefly the hydraulic features of the Columbia River because of its size and varying conditions. It has a drainage area of about 90,000 square miles above the Rock Island site, with climatic conditions providing a comparatively regular hydrograph. The drainage basin in the four northwest states and part of Canada has a somewhat arid climate



At Rock Island on the Columbia River below Wenatchee, Wash., is located the first major low-head hydro-electric plant built in the West.



Plan of dam, showing extent of flood gate section that handles average annual floodflows of 350,000 sec.-ft.

throughout the summer, with practically all the precipitation occurring in the fall and winter months. Much of this precipitation, falling as snow in the high mountain regions, is released in the spring from the many streams draining on the west slope of the Rockies and the east slope of the Cascade Range. Under regular conditions the river rises in the early spring and assumes flood conditions during May, June and July. Depending to a large extent on the amount of snowfall, the river develops floods which have reached a maximum of 740,000 sec.-ft.; this is the estimated flow in 1894. During July the floodflows normally begin to recede and by the middle of September the flow is usually less than 100,000 sec.-ft. During the fall and winter the stream continues to drop and reaches a minimum flow as low as 21,000 sec.-ft., the minimum of record. This is the usual annual cycle of the river which follows very regular characteristics, the average annual floodflow being about 350,000 sec.-ft.

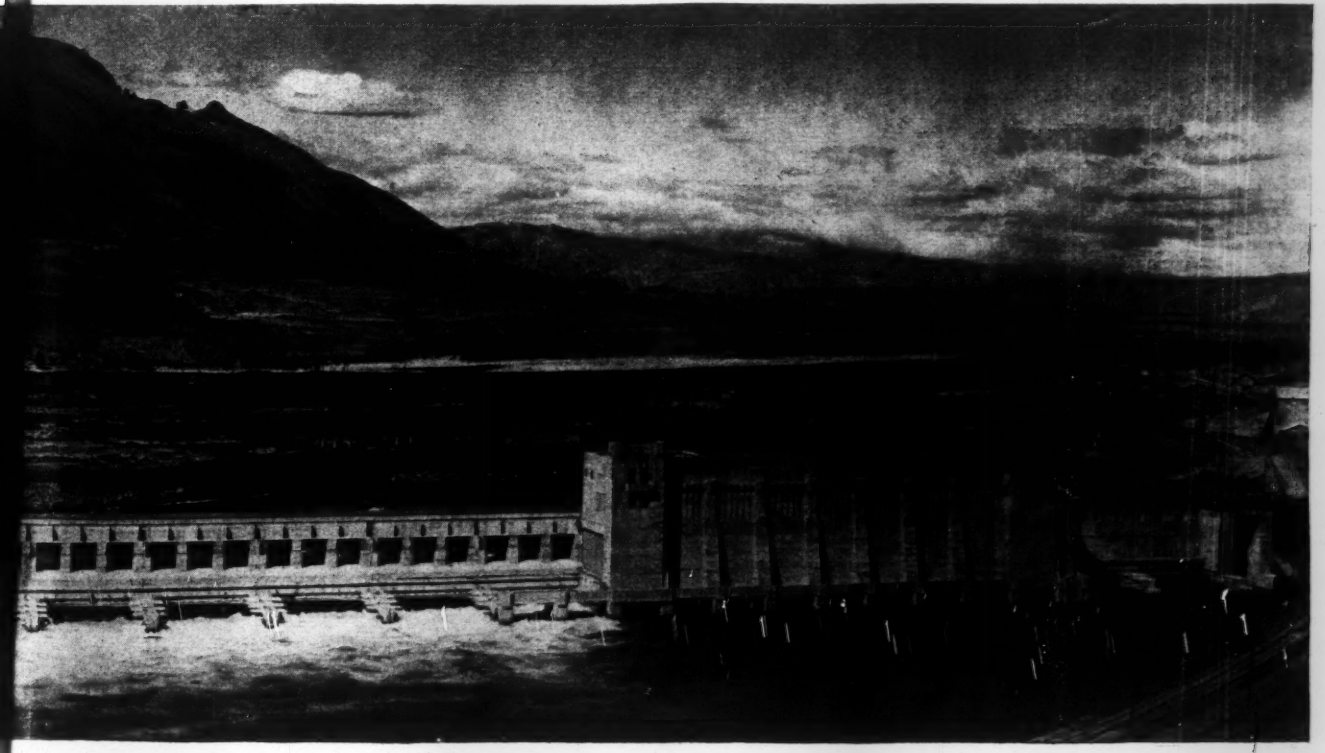
Because of the wide range of flow in the river, provision had to be made in the dam for both high floods and periods of very low flow.

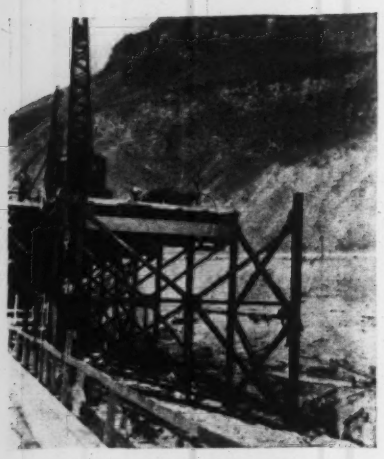
At the Rock Island site the fall of the river increases from an average slope of about 2 ft. per mile to about 7 ft. in high water stage in a distance of three-quarters of a mile. At low-water stage this total drop is about 15 ft. Because of physical conditions, which include a major highway and the main line of the Great Northern Railway, paralleling the east river bank near the site, the maximum economical head that could be developed at the location was 51 ft. The normal operating pond level at the dam will be at El. 600.

The project is unique among Western hydro-electric developments because it makes use of a large flow through a low head, whereas the typical Western development usually embraces the reverse condition. In many respects the development is similar to some Eastern projects but has none to compare with it in the West. In type and proportions it compares with the Osage River and the Conowingo projects. According to this general type of development, the power house is a part of a long gravity dam, extending from bedrock at El. 509 to the top of the superstructure at El. 671. The ultimate installation of twelve 21,000-hp. units will use about 4,500 sec.-ft. of water each at maximum head. Floodflow will be taken care of by unusually large-sized spillway openings so that the flow of the river will be interfered with only to a minor degree. The pond formed by the dam will back the water up a distance of about 20 miles, or 7 miles above the city of Wenatchee, but operation of the plant will be based on streamflow and storage will form practically no part of the operating plan.

Construction program

Because of severe climatic conditions varying from hot and dry summers with temperatures as high as 115 deg. to winter temperatures as low as 15 deg. below zero, the construction program was planned with regard to these conditions in addition to the hydrographic requirements. Placing concrete in the winter months would have to be done under severe climatic handicaps but with the distinct advantage of low flow in the stream. On the other hand, during the summer months, favorable for





Erecting construction bridge steel on the Rock Island development.

construction, the river would be at flood stage and only certain parts of the work could be carried on.

These opposed conditions necessitated careful study to secure an advantageous sequence of construction operations. The effectiveness of this program, considering the size of the development, the various contingencies of weather, river flow and other items, can be best judged by the fact that the work was started Jan. 26, 1930, and the two first units were placed in preliminary service, November, 1931.

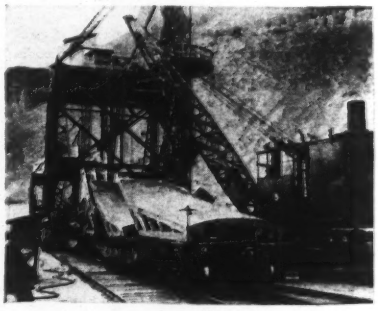
Preliminary work

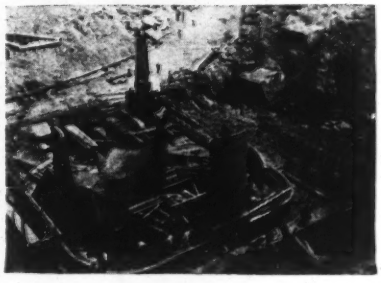
During the late winter of 1930 cofferdam construction was rushed in the east channel during the low flow period. These timber crib dams, one above and one below the site, extended from the east bank to the island and inclosed a 25-acre section of channel. They were submerged during the months of flood flow, but the return of low flow conditions in the fall of 1930 permitted the unwatering of the site for the spillway structure and power house. The cofferdamming operations, which provided the most hazardous part of the project, were described in detail in *Engineering News-Record*, April 30, 1931, p. 716. This general type of operation was repeated in the west channel the following season, diverting the river through openings left in the structure which had been completed in the east channel during one working season.

During the months when the east channel cofferdams were flooded, concreting operations were started on the north abutment, which extends along the east side of the river parallel to the highway. This long abutment structure, built at a sharp angle to the main dam, takes advantage of higher rock elevation upstream and accommodates a fish ladder. The abutment and fish ladder were completed during the flood season, making it possible to push operations in the main river channel as soon as diversion was possible.

Cofferdamming operations were so successful that after four days of pumping the site was unwatered. Foundation excavation was completed in 45 days to the point where pouring of the foundation slabs for the power house could proceed. The first concrete in the power house structure was poured Sept. 29, 1930, and this work was carried on continually until March 4, 1931, when both cofferdams were removed and the river was allowed to flow through the gates and openings left in the structure. During this period 150,000 cu.yd. of concrete had been poured and the power house structure for the initial units completed from foundation to roof.

The power house forms a part of the dam and extends halfway across the channel for a total length of about 8 ft., extending from bedrock at El. 5 to the top of superstructure at El. 6 Foundations were provided for all t twelve units, although the initial buil ing will house only four at the pres time. Provision was made so that t eight other units can be installed dropping the gates to close out the riv and pumping out the draft tube ope ings. The lower part of the draft tub





Sections of draft tube forms were brought out on the construction bridge on flat cars and lowered into position.

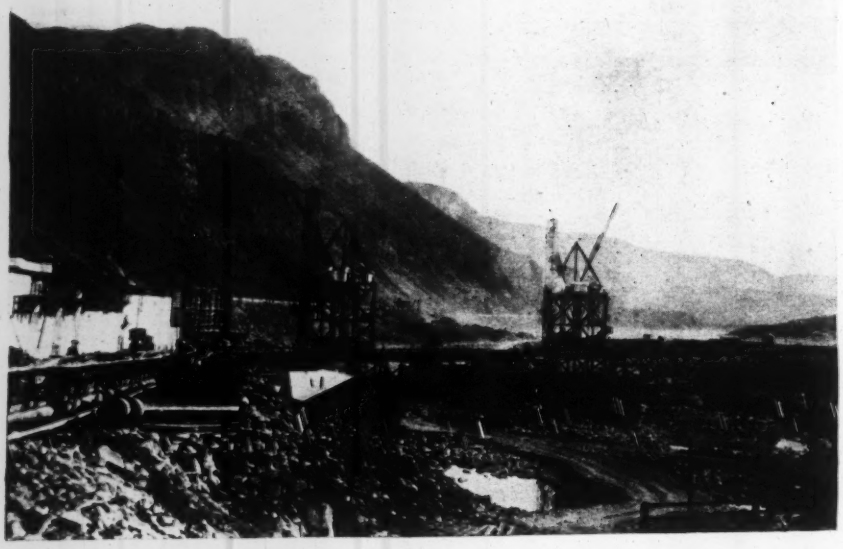
and part of the intake structures were also completed for six of the units.

Concrete-placing operations as well as the handling of all equipment were carried on by gantry cranes operating on a structural steel construction bridge across the channel immediately upstream from the dam and power house. The bridge was equipped with two lines of railroad tracks in addition to the tracks for the cranes. This method of construction is similar to that used on several Eastern projects. The bridge was carried across the river as foundation excavation proceeded so that the gantry cranes were available for handling reinforcing steel and framework in addition to the subsequent concrete pouring.

Concreting operations

Concrete was mixed in a plant equipped with four 1-yd. mixers, using aggregate excavated and prepared at a pit about 2 miles from the site and trucked to the concrete plant. The concrete proportion was varied according to the conditions and point of use, but the mix for the more massive sections of concrete was 1:3:5, and a 1:2:4 mix was used for the thinner sections in the

Unwatered east channel, showing north abutment at left and gantry cranes on construction bridge.



power house. Concrete was taken by train to the point of pour and either placed directly by chutes or elevated in a hoisting tower which formed part of the gantry equipment and delivered by counterweighted chutes.

When construction in the east channel had proceeded far enough to divert the water back in that waterway through the future power house intakes, the cofferdams were removed and part of the timber re-used for similar operations in the west channel. This second cofferdamming operation was similar to the work in the east channel, being submerged during the 1931 high-water period. Construction work in that channel, consisting of about 850 ft. of spillway structure and the south abutment, was started after the flood season and was completed about the middle of December. This work completed the major construction features in connection with the Rock Island project and subsequent work will be the addition of power units as required.

Plant installation

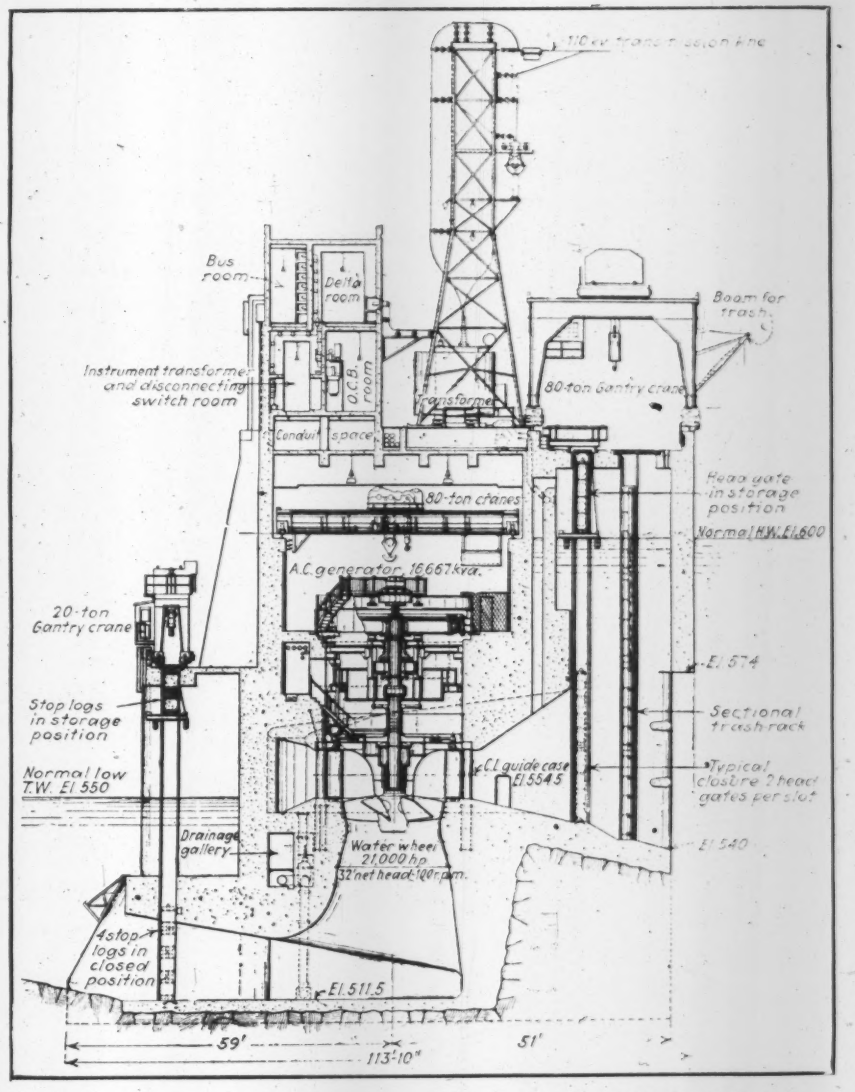
The present installation for power development consists of four 21,000-hp. propeller-type, vertical shaft waterwheels with the rotating part of the generator on the same shaft. The entire revolving unit is suspended from a vertical thrust bearing supported on girders placed just above the operating room floor. The runner is 18 ft. 9⅛ in. in diameter and consists of six blades attached to a central hub. Because of the large variation in operating head from a 51-ft. maximum for the ultimate development to a minimum of 20 ft., the runner for the unit was provided with adjustable blades for economical power output.

The scroll cases are of reinforced concrete, each of which has three headgate openings, 15 ft. 4 in. wide by 27 ft. 11 in. high. Draft tubes are of the modified elbow type.

The generators are of the umbrella type with a capacity of 16,667 kva.; and one 1,750-kva. waterwheel unit, similar in design to the main unit, was installed for station service power. The power supply from this plant is delivered over 128 miles of 110,000-volt transmission line to the Beverly Park substation of the Puget Sound Power & Light Co. near Seattle. The transmission line conductor, of copper cable, except over the mountain region, where the conductor is steel-reinforced aluminum cable, is supported on H-type structures of western cedar poles with fir crossarms.

Gates and control works

To handle the volume of water which passes the Rock Island site and the extreme range of flow, spillway structures and control works were an important feature of the development. During construction operations in the west channel the flow of the river was taken care of through openings ultimately to be occupied by six of the remaining power units. These do not form part of the actual river control works but were used during construction only.

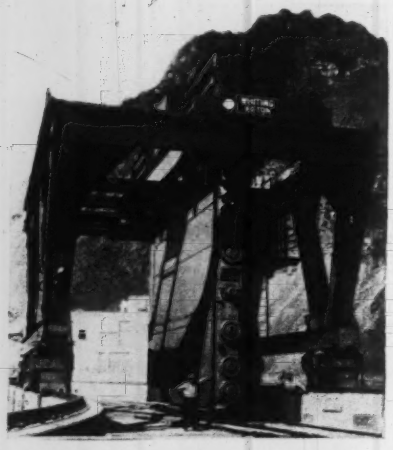


Cross-section through the power plant at Rock Island. The layout is remarkable for its compactness and for the entire absence of windows in the generator room.

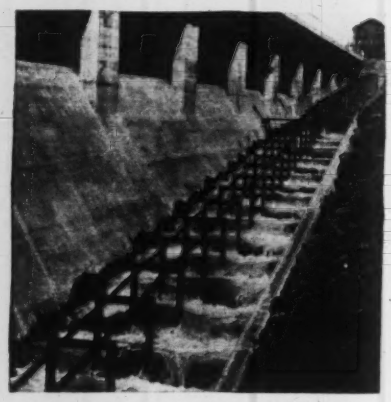
Immediately south of the power house structure as it will be ultimately completed is the east spillway. The entire spillway section extends across a portion of the east channel, the island section and the west channel over to the south abutment. Next to the power house are six gates 30 ft. wide by 41 ft. deep with sills at El. 559. There follow nineteen shallow gates 30 ft. wide by 18½ ft. deep with sills at El. 581.5. The remainder of the spillway section consists of twelve more of the deep gates 30 × 41 ft. There is a drop gate located immediately adjacent to the south abutment and one at the north abutment. During the initial stages of development the lower half of the deep gates only will be installed and the normal operating pond level will be maintained at the sill of the shallow gates, El. 581.5. When the seventh unit is added all the gates will be completed and the operating level raised to its ultimate elevation of 600 ft.

The drop gate used at the north abutment is to provide a constant flow of water for the fish ladder approach. It is a steel structure 22 ft. 3½ in. long and 7 ft. 6 in. high, weighing 22,250 lb. In addition to this gate there are also eight concrete-filled structural steel stop logs. There is a similar drop gate constructed at the south abutment for use in connection with a fishway on that side.

Each hydraulic unit is controlled by three steel headgates closing the three openings to the scroll gate. These gates are of the roller type and built in two



The crest gates are handled by a gantry crane operating along the top of the dam.



Fish ladder 500 ft. long on 1 : 10 slope provided with a steel framework for holding flashboards.

sections. They are so constructed that they can be used as stop logs to shut off the entire intake; this operation requires more sections of the gates. The draft tube of each unit can be closed by structural steel stop logs. Eight logs are required for each unit, each 28 ft. long and 2 ft. 8½ in. high. These are handled by a 20-ton gantry crane traveling on tracks above the position of the stop log guides.

For the present installation the deep spillway openings are provided with steel crest gates 31 ft. wide by 22 ft. 6 in. high. When the ultimate development is made, a second gate section, 18 ft. 6 in. high, will be added to make the total height of gate 41 ft. and gates will also be installed in the shallow openings. As has been noted, there will be no crest gates required for the shallow spillway openings in the initial development. An 80-ton gantry crane operating from the spillway deck will handle all the crest gates.

In addition to the spillway gates there is a regulating gate at the south end of the power house built in sections that can be used as a skimmer to remove trash and regulate the elevation when variation in river flow is small.

The operating head on the plant will vary from a maximum of 51 ft. to a minimum of 20 ft. When the flow of the river reaches a flood stage of 530,000 sec.-ft. it may be necessary to make even further reductions in operating head by opening gates to avoid excessive backwater, but such flows occur only about once in three years and continue for only a short period.

Streamflow conditions of the Columbia River at Rock Island are particularly advantageous in fitting into the hydro-electric power production from the other plants of the company. These are mostly high-head plants which produce maximum output with streamflows at flood stage, when the Rock Island plant will be producing on a restricted output because of the decrease in operating head between headwater and the high backwater. Conversely, when the high-head plants are restricted in output, the Rock Island development will have large supplies of water available and maximum operating head.

Fish ladders

One of the most unusual features of the Rock Island development is the provision of fish ladders required by the Federal Power Commission at the request of the U. S. Bureau of Fisheries. There are two ladders to be built immediately, one at each bank of the stream. They are of concrete or cut out of the rock for a length of about 500 ft. on a slope of 1 to 10. Each ladder is 20 ft. wide and is provided with pools 10 ft. long with a 1-ft. difference in elevation between pools. A regulated water supply is provided through suitable gates in the abutment.

The Stone & Webster Engineering Corp. has the contract for the design and construction of the entire development.

Hot Cement Has No Ill Effects in Concrete Paving

Tests made on alternate sections of Indiana concrete road paved with hot cement and cold cement indicate no damaging effects from high cement temperatures

CAREFUL TESTS in building the 6-mile Dunes Relief Highway, in northern Indiana, indicate virtually no differences in workability, strength, volume change, checking or cracking of paving concrete due to the use of hot cement of 180 + deg. temperature. The tests were a part of an investigation being made by a subcommittee of the cement committee of the American Society for Testing Materials as the result of requirements in the specifications of some state highway departments that cement when delivered on the job must not be above 125 deg. F. in temperature. At the meeting of the society in July, 1931, a recommendation was adopted that, pending the conclusions of the committee, the limiting clause be not used. The Indiana tests are the first results made public of any part of the subcommittee investigations.

Test conditions and procedure

Four sections of pavement of 9-8-9-in. section, 20 ft. wide and about 160 ft. long, were observed. Except for cement temperatures the concrete in all the sections was as nearly identical as is possible with modern paving equipment.

The following properties of the concrete were studied: workability, compressive strength, modulus of rupture, volume change, checking and cracking. Eighty 6x12-in. cylinders and twenty 6x6x½-in. beams were made during the investigation. During placing, frequent determinations were made of temperatures of cement, water and aggregate (immediately before entering the mixer), air and concrete (immediately after being discharged from the mixer), relative humidity of the air and weather conditions. The temperature of each section was determined at three different points 24 hours after placing.

Workability not affected

No occurrence of rapid setting approaching flash set was encountered with either cold or hot cement. No consistent relation was observed between cement temperature and slump of the concrete. On Sept. 4 the average slump of the cold-cement concrete was less than that of the hot-cement concrete. On Sept. 8 opposite results were noted. On both days the temperatures of the aggregates, water and air were greater during the placing of the hot-cement concrete than was the case during the placing of the cold-cement concrete. However, it is thought that this means little because of the lack of dependability of the slump test, especially under field conditions, and that little importance can be attached to the observed slumps of the two varieties of concrete.

On Sept. 4, during the placing of the

hot-cement section, the workmen shoveling the concrete over the subgrade expressed the opinion that this concrete was more easily handled than that in which cold cement was used. The finishers using the wood floats and the workmen doing the edging said that these operations had to be done more promptly than was necessary in the cold-cement section. The inspector was of the opinion that there was no difference in the finishing of the two sections and that the necessity for finishing the hot-cement concrete more promptly was neither an advantage nor a disadvantage so far as the quality of the finish was concerned.

On Sept. 8, during the placing of the cold-cement section, the finishers raised the objection that set was occurring more rapidly than was usual and that the concrete was sticky, which condition caused the concrete to stick to the floats and required that this operation be done rapidly. It was noted that apparently water was not coming to the surface, a condition contrary to that preferred by finishers. Inasmuch as this was the first instance of a criticism of any consequence during the investigation, attention is called to the weather conditions prevailing during the placing of this section. The weather was sunny and accompanied by a hot dry wind, and the temperatures of the aggregate, water and air were higher than was the case during the placing of either of the sections on Sept. 4. The relative humidity of the air was appreciably lower, a condition that would also be conducive to producing the condition of the concrete noted above.

During the placing of the hot-cement section the workmen shoveling concrete over the subgrade seemed to think the material was harder to handle than the cold-cement concrete placed earlier in the day. From the experience with the cold-cement section it was expected the finishers and edgers would encounter aggravated difficulties. Just the opposite was the case. During the finishing of the entire section these workmen said the concrete was more easily finished than the cold-cement section. At no time did the sticky or gluey condition occur. The inspector was of the opinion that the hot-cement section was finished more satisfactorily and called attention to the fact that no such dry spots were present immediately following the operation of the floats as had occurred during the placing of the cold-cement section.

In the hot-cement section placed on Sept. 8 the cement temperature was 87 deg. F. greater than that of the cement in the cold section, and the temperatures of the aggregate, water and air had increased slightly, with a consequent increase in concrete temperature of 9.3 deg. F. In spite of these conditions, undesirable workability characteristics did not occur at any time during the placing of the section. During the placing of the cold-cement section a hot dry wind prevailed, which had subsided by the time the hot-cement section was started.

TEMPERATURES, HUMIDITY, WATER CONTENT AND SLUMP OF HOT- AND COLD-CEMENT CONCRETES

Date	Section No.	Temp. of Cement at Transfer Platform	Temperatures at Mixer—Cement	Agg.	Water	Air	Temp. Concrete After Mixing—Observed	Computed	Relative Humidity Air, Per Cent	Water Per Batch, Gal.	Slump, In.	Temp. Conc. in 24 Hours	Weather
Sept. 4	1	79.3	77.0	68.7	83.9	71.6	76.0	73.4	82.0	29.20	1.6	80.2	(1)
Sept. 4	2	173.0	154.0	73.6	96.7	78.0	89.1	89.0	69.2	29.50	2.8	76.0	(2)
Sept. 8	3	77.5	80.4	77.4	101.5	87.1	85.1	83.6	46.7	31.75	3.7	91.5	(3)
Sept. 8	4	175.8	167.4	80.6	102.4	90.4	94.4	96.6	50.8	31.38	2.4	91.8	(4)

(1) Weather at start, cloudy and slight breeze. Air temperature increased constantly. During latter half of period sunny and increased wind. (2) Mostly sunny and windy. (3) Sunny and hot, dry wind. (4) Partly cloudy, breeze.

Strengths about equal

At 7, 14 and 28 days the hot-cement concrete was slightly stronger in compression than the cold-cement concrete. At the age of three months the strengths of the two kinds of concrete were virtually equal. The modulus of rupture of the hot-cement concrete was somewhat less than that of the cold-cement concrete at all ages, with the exception of that at fourteen days. The results of the fourteen-day tests are subject to question because of the inconsistent relation between the seven- and fourteen-day strengths of the cold-cement concrete. However, the difference between the results of the cold and hot cement is in general less, or but very little greater, than the average mean variation of individual tests from the average.

The cores drilled from cold-cement sections were slightly stronger in compression than those drilled from hot-cement sections.

Conclusions

Data to the age of three months do not indicate that the use of hot cement (maximum temperature at the mixer, 167 deg. F.) is of consequence in road paving as to its effects on workability, compressive strength, volume change, checking and cracking. On the only occasion on which impaired workability was encountered in this investigation, cold cement was being used, and apparently adverse weather conditions were responsible for such difficulties as were encountered. It is likely that such weather conditions would have a similar and possibly a more pronounced effect on the workability of concrete in which hot cement was being used.

The compressive strength of the hot-cement concrete, as indicated by 6x12-in. cylinders, was slightly greater at 7, 14 and 28 days, but at the age of three months it was essentially equal to that of the cold-cement concrete. The results of the compressive tests on cores (at three months) indicate the cold-cement concrete to be slightly stronger.

The volume changes that occurred in the sections of cold and hot cement did not differ sufficiently to warrant a distinction. Checking did not occur in any of the sections of cold- or hot-cement pavement, and the crack survey at 32 days, although conducted over shorter lengths of pavement than are desirable for this purpose, indicated no distinction between the two kinds of concrete. The effect of the hot cement was to reduce to some extent the modulus of rupture. These results of the study of flexural strength indicate that the use of hot cement may be slightly detrimental to this property of concrete, especially at early ages. The fact that the difference between the moduli of rupture of the two kinds of concrete decreases with increase in age indicates that at later ages the moduli may be equal.

On considering these conclusions it should be borne in mind that the tests were conducted during a season of the year when maximum summer temperatures do not occur. The average air temperature during the placing of the two hot-cement sections was 84 deg. F. Perhaps during the middle of the summer, when the maximum air temperature in this locality is somewhat higher, different results might be obtained, especially if the unusual air temperature is accompanied by dry wind and low relative humidity. However, the experience with cold cement on one occasion would lead to the conclusion that such a combination of weather conditions would affect the workability of concrete in which the cement is at normal temperature.

Creosoted-Timber Pontoons

To accommodate heavier engines, the Chicago, Milwaukee, St. Paul & Pacific Railroad has built a new creosoted-timber pontoon, 396 ft. long and 50 ft. wide, for the channel opening of its bridge over the Mississippi at Wabasha, Minn. The approaches total about 2,400 ft. of pile trestles. This bridge serves a branch line, and the road has similar pontoon bridges on this river and the Missouri. An interesting feature of the pontoon is that the timbers were all framed, shaped and bored before treatment.

Sewer Construction on Temporary Trestle Through Marsh

One section of cast-iron outfall with lead joints for Hudson, N. Y., assembled in a 244-ft. length in cable slings and lowered as a unit

By Thomas F. Bowe
Consulting Engineer, New York City

BOTH PIPE LAYING and excavation were conducted from a temporary wooden trestle in constructing a 24-in. cast-iron outfall sewer for Hudson, N. Y., through a long stretch of tidal marshland. The trestle was built of timber pile bents and carried a wide-gage track on which was mounted a specially built traveling crane. To reach the deep water in the Hudson River the line had to pass under a low railway bridge, which made the use of a barge impractical.

The trestle extended from the mainland to the river channel. Within the limits of marshland and bay a row of pile bents was driven on 12-ft. centers. Each bent was 15 ft. wide and consisted of four piles, spaced 9 ft. apart at the center and 3 ft. at the sides. The piles in each bent were capped with a 10x10-in. timber, and stringers of the same size were placed on 12-ft. centers over the line of the proposed pipe line. Light rails were then spiked to the stringers, affording free movement for a crane.

It was not possible to drive piles in the vicinity of the railroad due to the rockfill upon which the roadbed was constructed. Timber cribs forming two parallel rows 9 ft. apart were floated and sunk into position along this part and made stable with riprap. They were braced longitudinally by stringers, and laterally by anchored cables and cross-ties. A trackway was then placed upon this structure.

A crane, designed and constructed by the contractor, John S. Thompson, was used. It consisted of a rectangular steel frame with an A-frame and boom at one end and a two-drum hoist at the other. The frame was made up of structural-steel channels and equipped with flanged wheels to fit the track. The A-frame was 12 ft. high and was of 8x8-in. timbers, tied back by two 1½-in. rods. The 8x10-in. boom was 36 ft. long and made of fir. Two cubic yards of stone in a box behind the hoist served as ballast.

The crane was assembled and mounted on the rails as soon as sufficient length of trestle had been completed, and it was used for driving the remaining piles and for handling the heavy timbers. After completion of the trestle a clam-shell bucket was attached to the boom and used for excavating the trench.

Owing to the small clearance it was not possible to operate the boom under the plate-girder railroad bridge. From this point on, the bucket was rigged from a low truck mounted on rails and powered from the crane hoist. This method required depositing the excavated material within reach of the crane, a procedure that necessitated rehandling.

Although flexible-joint pipe was employed, the specifications required a satisfactory 15-lb. air test, and the contractor considered a minimum displacement of the lead joint to be advisable and wished to avoid underwater caulking. The pipe was suspended in cable slings, to which were attached threaded rods 12 to 14 ft. long. These rods, every 12 ft., passed through 4x12-in. timbers laid across the stringers and were supported by steel plates and handwheels.

A section of pipe 244 ft. long was assembled above the water surface, joints were run with lead and then tested with air pressure. Leaky joints were made tight and the entire assembly lowered into place as a unit.

Along the rest of the line it was possible to bulkhead off the water and lay a length of pipe at a time. All operations, however, were carried on from the trestlework until solid ground was reached.

The completed line was tested under the specific pressure and found to be tight along the length that had been suspended by rods. Those joints that leaked were located in the bulkheaded portion and were all accessible for repair. The completed line was then backfilled from the trestle.

The trestle was subsequently removed by using light charges of ring dynamite to cut off the piles.

The contract included 447 ft. of 24-in. flexible-joint pipe, 340 ft. of 24 bell-and-spigot pipe, and 110 ft. of twin 14-in. cast-iron pipe. The line was constructed by the Thompson Construction Corp., of Hudson, N. Y., for a contract price of $21,700. The work was designed and supervised by the writer. Kenneth D. Allen was resident engineer.

Fig. 1—Excavation and pipe laying were done by a specially designed traveling crane operating on the temporary trestle.

Fig. 2—In carrying the line under a railway bridge, the restricted headroom required a lower construction trestle, supported by rockfilled timber cribs.

Yard Switching by Cable Car

Cable cars or barneys, used for flat switching in a classification yard at Chemnitz, Germany, operate on narrow-gage tracks between the running rails of the switching leads. They are handled by a remote-control system from an elevated cabin, the operator in which has communication with the yard switchmen by means of loud speakers. Except that the tracks are level, the cable system is similar to that commonly used in this country for pushing cars up steep inclines onto coal docks, while the remote-control system corresponds to the handling of motor dump-cars at quarries and other industrial works.

Wrecking Home Insurance Building Reveals Excellence of Old Metals

First skeleton-frame building, dismantled to make way for new Field Building in Chicago, was built of cast iron, wrought iron and the first steel beams used in a building in this country

By Henry Penn
District Engineer, American Institute of Steel Construction, Chicago, Ill.

THE FAMOUS Home Insurance Building in Chicago has recently been demolished to make way for Chicago's largest office structure, the Field Building. This early skyscraper, now declared by a board of investigating architects to have been the first skeleton-frame building, yielded its place not because of physical deterioration but because it could no longer produce the necessary revenue. During the demolition process an opportunity was offered to study the structural details of the building and to examine the microstructure of the early cast iron, wrought iron and steel of its frame. This article presents some of these data.

When William LeBaron Jenney conceived the design of the Home Insurance Building and started its construction in 1884, he was striving like architects of today, for greater efficiency in buildings. For one thing, he wanted large window areas, but to achieve this it was necessary to omit so much masonry that that remaining in the wall was not strong enough to carry its own weight and the weight of the adjacent floor and its loads. To eliminate this difficulty, he therefore placed metal structural members in the walls to carry not only the adjacent floors and floor loads but the wall masonry as well. A quotation from Mr. Jenney's writings throws interesting light on the subject: "In the Home Insurance Building all the columns are of cast iron and, with few exceptions only, all the I-beams of wrought iron. A few steel beams were used, the first manufactured in America, so that this building enjoys two distinctions. It was the first to use constructional steel and was the building for which the Chicago construction was invented and in which it was first used." [The subject of the first skeleton-frame building was discussed by H. J. Burt in *Engineering News-Record*, April 17, 1924, p. 680, in which he concluded that the Home Insurance Building was a "near approach" to the skeleton-frame building, but the Tacoma Building built in Chicago in 1886 had "true skeleton" construction. It is probably true, as a recent investigating committee of the Western Society of Engineers states that the skeleton type of building is not the invention of any one person or the development of any one year but the development of a period.—EDITOR.]

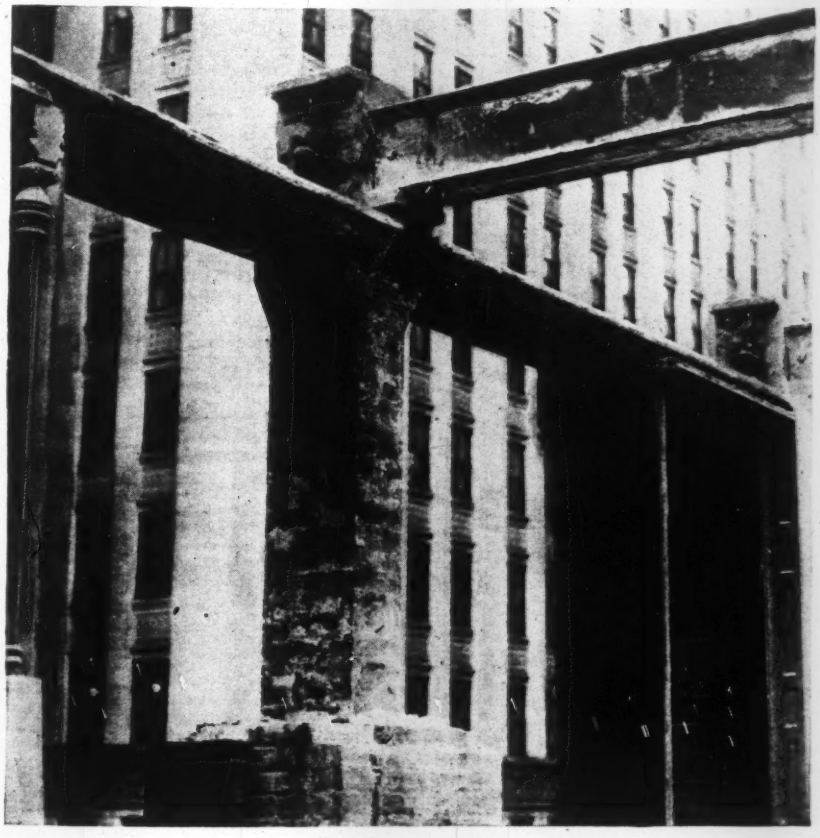


Fig. 1—Framework of Home Insurance Building, Chicago, early skeleton-type structure with cast-iron columns and lintels and wrought-iron floor beams. In one floor, steel beams, the first rolled in this country, were substituted for the wrought-iron beams.

COMPARISON OF METALS IN HOME INSURANCE BUILDING WITH MODERN STRUCTURAL STEEL*

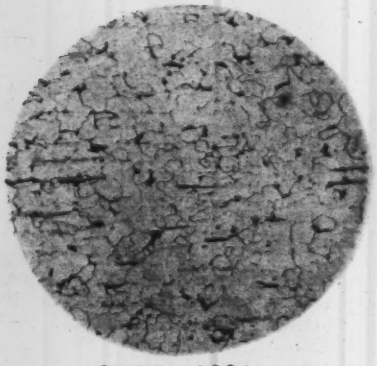
		1884		1890	1931	
Properties	Cast Iron	Wrought Iron	Bessemer Steel	Bessemer Steel	Open-Hearth Steel	Silicon Steel
Chemical						
Carbon	3.29	0.02	0.08	0.15		0.40
Manganese	0.51	0.03	0.37	0.53		
Silicon	2.27	0.20	0.02	0.02	Min.	0.20
Sulphur	0.08	0.07	0.06	0.08		0.05
Phosphorus	0.51	0.45	0.14	0.22	0.06	0.04
Physical						
Tensile strength (lb. per sq.in.)		50,250	60,820	63,310	55 to 65,000	80 to 95,000
Yield point (lb. per sq. in.)		35,330	46,450	43,500	27,500 to 32,500	45,000
Elongation in 8 in. (per cent)		10	21	28.5	21.5	15.8
Reduction of area (per cent)		15.9	50.78	52.21		30.00
Fracture		Fibrous	Silky cup angular	Silky angular		

* Chemical analyses, photomicrographs and physical tests by Robert W. Hunt & Co.

When the construction of this building was begun in 1884, the materials available for the structural frame were wood, cast iron and wrought iron. Apparently wrought-iron columns and assemblies of rolled wrought-iron sections were yet undeveloped, for heavy cast-iron columns—either hollow rectangles (for those buried in the masonry) or hollow round sections—were used. Lintels of cast iron and beams of rolled wrought iron rested on brackets cast integral with the cast-iron columns, and usually the beams were held in place by means of bolts through drilled holes in the beams and cored holes in the castings. The entire assembly of structural materials was bolted sufficiently to stay it, but the bolted joints were not used to transfer loads from one piece to another. To stiffen the construction and at the same time to

WROUGHT IRON 1884

CAST IRON 1884



STEEL 1884

STEEL 1890

Fig. 2—Photomicrographs of cast iron, wrought iron and steel used in old Home Insurance Building in Chicago.

permit lengthwise adjustment of the beam-to-column connections, a hook bolt was used, one end passing through a hole in the column and the hooked end fastened in a slotted hole in the beam.

By the time the Home Insurance Building was erected to the six-story level, the Carnegie-Phipps Co., predecessor of the Carnegie Steel Co. and the manufacturer of the wrought-iron beams being used, had succeeded in rolling the first bessemer-steel beams. Permission was asked and granted to use one shipment of steel beams in place of the wrought-iron beams. The author has succeeded in recovering some of these original steel beams, and in the accompanying table the analysis and physical properties of this 1884 steel are compared with the cast and wrought iron.

It will be noted that the cast iron (used in the columns and lintels) is of a grade that might commonly be found at present in agricultural machinery castings. Its chemical analysis shows nothing extraordinary, its physical characteristics would indicate it to be sound for the use for which it was intended. Examination showed it had not suffered from corrosion nor changed with time. The wrought-iron beams of 1884 show a chemical content very similar to a common analysis of the material th known as iron. The tensile strength tabulated is lower than the mild steel common use today, but the material h good structural properties.

Two stories of steel columns a beams with riveted connections we added to the building in 1890. The d tails of connections would appear uniq to a modern fabricating shop, but th were high class for the day in whi they were used. The columns we made up of the Phoenix sections. Th steel had the usual characteristics bessemer steel.

All steel sections when removed we as good as the day they were first place Corrosion appeared only where a leak ing tank had been supported on unpro tected steel. The framing of the origi nal building had not been painted. Th steel of 1890 was painted with red lead

There has been added to the accom panying table the chemical and physica properties of modern open-hearth steel now in common use for buildings and 1931 silicon steel that will be used in the new Field Building. Study of the table and the photomicrographs will indicate the trend of the materials from 1884.

Simplifying Design and Control of Concrete Mixes

Method involves keeping aggregate gradation and water content per unit of concrete constant and use of straight-line relation between strength and cement-water ratio by weight

By Inge Lyse

Research Assistant Professor of Engineering Materials, Lehigh University, Bethlehem, Pa.

IN THE graduate course in plain concrete at Lehigh University during the current semester a method of designing concrete mixes is to be used that may have practical utility in general engineering practice. Briefly, it involves the use of the cement-water ratio by weight theory discussed by the writer (*ENR*, Nov. 5, 1931, p. 723) and is intended to simplify greatly the field control of concrete mixes.

A valuable simplification in the design and control of concrete mixes was made possible by the discovery that the consistency of concrete mixes remains constant, regardless of the richness, if the gradation of the aggregates and the water content per unit of concrete remain constant. To the writer's knowledge this discovery was first presented by F. R. McMillan in the first of his articles on basic principles of concrete making (*ENR*, April 11, 1929, Fig. 1, p. 582). Since January, 1930, the Fritz Engineering Laboratory of Lehigh University has successfully made use of this discovery in the design of all concrete mixes used in its investigational work. (A brief description of the principles of this design was first published in a paper by Slater and Lyse in *Proceedings*, American Concrete Institute, 1930, p. 831.) The use of the straight-line relation between the cement-water ratio by weight and the strength of the concrete will further simplify and extend this method in the design and control of concrete mixes. In order to focus the attention of the engineering profession on this method, which requires only one trial batch and simple computations for the design of a series of concrete mixes, a detailed description of the procedure being followed at Lehigh University is given in the following:

Fig. 1 illustrates the percentages of the total volume of concrete occupied by the different ingredients. With the same gradation of the aggregates (sand-coarse ratio 1 : 2), the net water content per unit of concrete remains con-

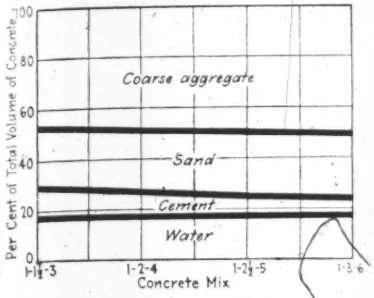


Fig. 1—Relative amounts of ingredients in a given volume of mixed concrete.

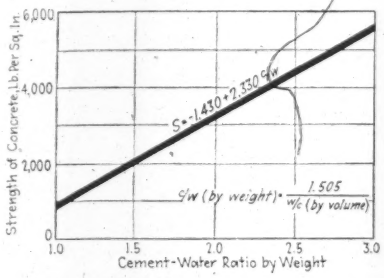


Fig. 2—Straight-line relation approximating Abrams' and Talbot-Richart's curves for average conditions.

stant for all the mixes having the same consistency (slump 2 to 3 in.). When dry aggregates are used, the water content should be increased by the amount of water absorbed by the aggregates. For the type of aggregates used at Lehigh the amount of water added for absorption corresponds to 1 per cent of the weight of the dry aggregates. The net water content shown in Fig. 1 is 17.8 per cent, corresponding to 36 gal. per cubic yard of fresh concrete.

The first step in utilizing this method for designing a concrete mix is to fix by trial batches the gradation of aggregates to be used. The next step is to determine the amount of water per unit of concrete necessary to produce the desired consistency; one determination is sufficient for all mixes. The rest of the design is a matter of computation.

Using 1 cu.yd. as the convenient volume of fresh concrete, the following equation can be set up:

1 cu.yd. concrete = absolute volume water + absolute volume of cement + absolute volume of aggregates

$$= \left(\frac{W_w}{27\times62.4}\right) + \left(\frac{c}{w}\,\frac{W_w}{27\times62.4\times3.10}\right) + \left(\frac{W_{ag}}{27\times62.4\times2.65}\right)$$

where

W_w = weight of water (lb.).
W_{ag} = weight of aggregates (lb.).
c/w = cement-water ratio by weight.
27x62.4 = weight (lb.) 1 cu.yd. of water.
3.10 = specific gravity of cement.
2.65 = specific gravity of aggregates.

Since W_w has been determined by trial batch and a cement-water ratio is chosen, the only unknown in the equation is W_{ag}, the weight of the aggregates. Practically all concrete mixes in present-day practice utilize cement-water ratios between 1.0 and 2.5. If these values are selected as the desired cement-water ratios for the determination of the strength-cement-water relation for the materials used, the procedure is as follows: for $c/w = 1.0$, and water content = 36 gal. = 300 lb. per cubic yard, the equation becomes:

$$1 = \frac{300}{27\times62.4} + \frac{1.0\times300}{27\times62.4\times3.10} + \frac{W_{ag}}{27\times62.4\times2.65}$$

or: $W_{ag} = (1 - 0.178 - 0.057)\ 4,460 = 3,410$ lb.

Using a sand-coarse aggregate ratio of 1 : 2, the amount of sand would be $\frac{1}{3}\times3,410 = 1,140$ lb., and the coarse aggregates $\frac{2}{3}\times3,410 = 2,270$ lb. Thus, such a mix would include 300 lb. cement, 1,140 lb. sand and 2,270 lb. coarse aggregate, which is: 1 : 3.8 : 7.6 by weight.

For a cement-water ratio of 2.5 the equation becomes:

$$1 = \frac{300}{27\times62.4} + \frac{2.5\times300}{27\times62.4\times3.10} + \frac{W_{ag}}{27\times62.4\times2.65}$$

or: $W_{ag} = (1 - 0.178 - 0.144)\ 4,460 = 3,030$ lb., and the mix by weight is: 1 : 1.35 : 2.70.

A simple method of designing concrete mixes after one mix has been determined is to make use of the fact that the absolute volumes of the solids remain constant for concrete mixes of different richness if the water content per unit of concrete remains constant. In changing from a lean to a rich mix the absolute volume of the cement is increased by an amount $\frac{W_{c_1}}{27\times62.4\times3.10}$, where W_{c_1} is the increase in the weight of the cement. The absolute volume of the aggregates must decrease a corresponding amount—that is,

$$\frac{W_{ag_1}}{27\times62.4\times2.65} = \frac{W_{c_1}}{27\times62.4\times3.10}$$

Thus, for an increase of 1.0 lb. in the cement a decrease of 2.65/3.10 = 0.85 lb. is required in the amount of aggregates. In the designs given above the cement content was increased from 300 to 750 lb. per cubic yard of concrete when the cement-water ratio was increased from 1.0 to 2.5. The increase in cement content was 750 minus 300 = 450 lb., and the corresponding decrease in the amount of aggregates was 0.85 times 450 = 380 lb., which checks the value given above (3,410 lb. — 3,030 lb. = 380 lb.).

Since the relation between strength and cement-water ratio by weight is a straight line, the strength results for concrete having ratios of 1.0 and 2.5 determine the strength of concrete mixes having cement-water ratios within this range. Fig. 2 shows the straight-line relation that approximates the strength curves for average conditions given by Abrams as—14000/7$^{w/c}$ and by Talbot-Richart as $32{,}000\left(1+\frac{c}{w}\right)$

If it is desired to change from one strength of concrete to another, the change in cement content is obtained by multiplying the difference in the cement-water-ratio for the two strengths by the constant water content of the concrete. For 1.0 lb. change in cement content a change of 0.85 lb. must be made in the aggregate content, and the new mix will have about the same consistency as the original mix. Thus, the whole question of changing from one strength of concrete to another is simply to maintain the amount of water used in the original mix, add or subtract the amount of cement required to give the desired change in strength, and subtract or add 0.85 lb. of aggregates of the proper gradation for each 1.0 lb. change in cement content.

Power From Sludge Gas

The Birmingham, Tame and Rea District Drainage Board in England proposes to spend £30,500 (about $150,000 at normal value of the pound) on a scheme for the utilization of sludge gases for power purposes at its Colehall sewage treatment works. A similar plant is already in operation at the Saltley works.

The new scheme is designed to treat 50,000 cu.yd. of crude sludge per annum and provides for the construction of seven 31x61-ft. primary sludge-digestion tanks, each with a floating gas collector of wrought iron covering the full area of the tank, and four secondary slude-digestion tanks of similar size. Two gas-driven electrical generating sets are also included, together with electrically operated pumps and a gas-fired water heating system. The whole plant has been designed by H. C. Whitehead, engineer to the board.

The method of operation is to pump fresh raw sludge from the sedimentation tanks into the primary digestion tanks, where it mixes with the actively fermenting sludge already in the tanks and promotes fermentation. In due course the sludge is delivered into a secondary digestion tank, where the process of digestion is completed, and from there it is run on to the usual drying beds, where the water content is reduced to about 35 per cent. In the digestion process itself about one-third of the dry, solid matter in the sludge is converted into liquid and gaseous products, and these gases (mainly methane) are collected from the primary tanks by the floating iron covers.

Sand-Clay Road Construction Applied to Tennis Courts

Layout at Duke University exemplifies good construction and planning for this type of work

By George C. Love
Civil Engineer, Durham, N. C.

THE building of a group of about twenty tennis courts on the west campus of Duke University involved a considerable grading operation and the building up of a suitable playing surface that was economical both in first cost and maintenance. The layout arrangement shown in the accompanying drawing was planned to facilitate construction by machinery, although considerable hand labor was necessary on the drainage and water-supply systems, in erecting fences and placing the posts for nets. The arrangement also simplifies maintenance because, although the work is done by hand, the various drags, mats, brushes and rollers used can be drawn in long continuous lines, with a minimum of turning and delays. When the courts are busy about all of every day, the labor of maintenance, including fresh marking daily, is seldom more than two hours for each court.

Tennis courts even in large numbers are not usually considered major engineering construction operations, but engineers and contractors are often called upon to build them, as the writer has been in recent years. Some general remarks, therefore, as well as a description of the work at Duke University, may prove useful.

Several types of hard surfaces have become popular for tennis courts where the cost is not prohibitive and where people can be induced to play upon the hard unyielding pavements copied from streets and highways. But there is an intermediate and less expensive material also long known to highway engineers, consisting of a mixture of sand and clay in proper proportions, that will afford a good tennis court surface. The theory of construction is to proportion the sand and clay to fill the pores of the sand and to mix them so intimately that there are neither lumps of clay nor pockets of loose sand left in the surface. This gives a material of great density, the sand providing hardness and the clay binder toughness under a wide range of weather conditions. In practice the necessary sand may be added to a natural clay surface, the clay applied to a sandy site or a natural or artificial mixture of sand and clay used to cover undesirable materials. Too often tennis courts are graded and used with no improved surface material when sand-clay materials are easily accessible.

Generally the courts are located with the net line east and west, but this arrangement can be improved somewhat by pointing the net line 10 or 15 deg. to southward of west so as to minimize the sun in the players' eyes in late afternoon when the sunshine is most blinding. Sufficient length for a court is 120 ft. (including runway space behind the base lines), although some are built longer and some shorter. Minimum width for one court for the doubles game (including clear space along each side line) should be 60 ft. to comply with established regulations.

When a number of tennis courts can be arranged in a group similar to those constructed at Duke University, 50 ft. is ample width for the courts inside the group. Those lying along the outside will need at least 5 ft. additional width to give the unobstructed space required by regulations for match games.

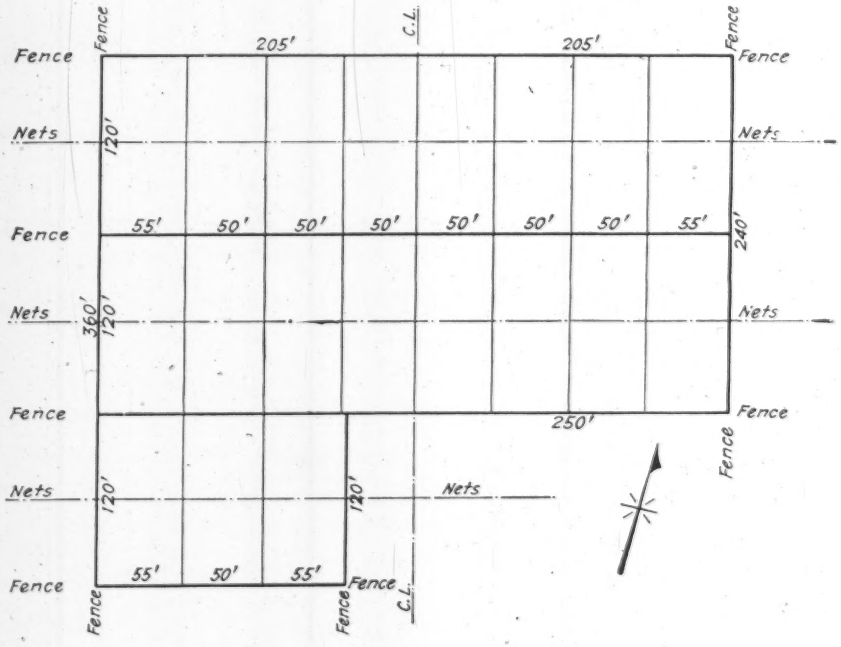
The fence around the inclosure and for backstops need not usually be over 10 ft. high, although a 14-ft. fence is better. Woven-wire fences similar to those inclosing factories and industrial establishments are semi-permanent and desirable if funds allow. Otherwise, poultry wire will serve while it lasts.

Tennis courts should be nearly level, having due regard to effective surface drainage. Lengthwise, slope should be both ways from the net or toward it from the ends. In the accompanying layout surface slope was ½ of 1 per [illegible] from the net, making the middle of [illegible] court about 3½ in. higher than the [illegible]. Also, all the courts in this group [illegible] transverse slope from the center [illegible] axis of the group at the rate of 0.5 [illegible] cent, making the outer side 3 in. [illegible] for drainage.

Sufficient underdrainage will keep [illegible] groundwater down in all weather. In the Duke University plan each court is surrounded by terra cotta drainpipe laid with open joints to admit percolating ground water. These drains are laid a minimum of 18 in. deep to carry flow in the same direction as the surface drainage, but the gradient is steeper, being 1 per cent. The trenches are back-filled with coarse crushed stone and covered throughout with a 6-in. layer of sand on top to admit percolation from the surface. At the corners of each court and at each edge opposite the nets are depressed stormwater inlets with flat iron gratings to admit stormwater to the outlet drains. This prevents long flows of water on the surface and insures the quickest possible drainage.

The site of these tennis courts was quite rugged and was graded by a steam shovel. In places the cutting was as much as 8 ft. deep and some of the fills were about as high. The grading was done and the fills allowed to settle through a winter before undertaking the finishing operations. The surface then was mostly a yellowish clay containing considerable sand. More sand was brought from near-by creeks and spread uniformly to a depth of about 2½ in. This coat of sand was then thoroughly mixed with the underlying clay, using a disk harrow and a tooth harrow drawn by a tractor. The mixture was saturated with water repeatedly and dragged smooth with a road machine, then rolled alternately parallel to the two axes with a 5-ton and a 10-ton

Extensive tennis court layout at Duke University, upon which a sand-clay surface has been built up.



power roller. This process was continued until the whole area was satisfactorily mixed, graded and consolidated.

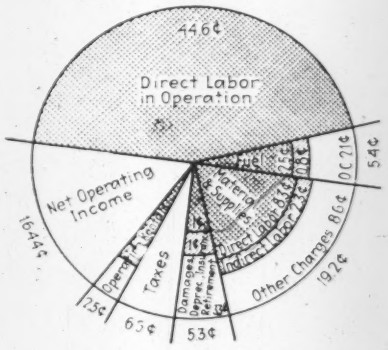
Blue granite screenings crushed to about the size of coarse sand were then applied as a thin top dressing and rolled into the wetted surface. This gave a hard compact surface mixture comparable to a first-class sand-clay road. Top dressing with the granite screenings reduces the glare, improves the color, reduces dust and prevents mud.

These courts have given satisfactory service for about a year and have proved to be easy to maintain.

Labor Receives Three-Quarters of the Money Spent for Roads

ADVANCING the argument for continued readbuilding as a means of employment, the New Jersey Constructors' Association has prepared the accompanying charts of money distribution. The charts are intended to give only a general graphical picture of cost subdivision. The assumption for indirect labor is the conservative one that for every man employed directly on the road, two are employed in the production and transportation of the essential materials entering into road work. In tracing the expenditures the wage account has only been checked back as far as the payrolls of the manufacturers and materials men. If the investigation were extended further, there would be shown a still larger percentage returned to the workmen. A study of the charts shows that the percentages of direct and indirect labor are very nearly the same for both road and bridge construction, so that 76c. out of every dollar spent for highway construction will go to the workingman regardless of the distribution between road and bridge construction.

Freight Charges


44.6¢
Direct Labor in Operation
Net Operating Income
16.4¢
Taxes
6.5¢
Other Charges 19.2¢
5.4¢
5.3¢
5.3¢
5.3

Chemical Treatment Adopted for Dearborn's Sewage

Precipitation and sludge dewatering aided by pulped paper effluent filtered through thin bed of magnetite—Lifted by magnet for washing

SEWAGE TREATMENT by chemical precipitation is about to be used in the plant just completed at Dearborn, Michigan. This time, however, a new clarifying element is to be introduced—pulped waste paper as a ready-made floc. The pulp is to be introduced along with lime and ferric chloride; its fibers, serving as nuclei for floc formation, are also expected to facilitate greatly the subsequent vacuum filtration of the undigested sludge. A further departure from the more frequently employed treatment methods is the use of very rapid upward filtration of the precipitation-tank effluent through a thin layer of magnetite that is to be periodically cleaned by a traveling magnetic device. The method of disposing of the dewatered sludge has not yet been determined.

The visitor at the plant is impressed with the marked dissimilarity between it and the more usual sewage-works. There are no units out in the open. Pumps, screens, tanks, sewage and sludge filters, chlorine equipment and the machinery peculiar to the Dearborn plant are all housed in one building, and the exterior of that building has more resemblance to a neat village high school than to a sewage plant. Within the building the impression is one of a chemical plant, with machinery, conveyors, ventilating ducts and overhead cranes very much in evidence. Mark B. Owen, the city's commissioner of public works and engineering, says that the completed plant will be practically identical in type with one using the cyanide process of gold extraction.

Present sewage flow from the tributary area is 2.75 million gallons daily, but the units of the new plant are designed to have a capacity of 8 m.g.d. An Imhoff-tank plant on the east side of the city now treats 15 m.g.d., but it is to be modified so as to give plain sedimentation to 30 m.g.d. All the sludge from the old plant is to be pumped through 3 miles of 8-in. pipe to the new plant, where it will be added to the influent of one of the settling tanks.

As thus far planned no biological process is to be used in the treatment of Dearborn sewage. Solids are to be separated from the sewage by chemical and mechanical means only, producing a clear effluent to be discharged into the River Rouge and a highly concentrat cake of sewage sludge.

Practically all the re-agents will waste-utilization products. Waste li is to be obtained at a low price from near-by acetylene plant Ferric chl ride is to be manufactured at the sewa plant by applying chlorine to tin ca and scrap metal collected with the city refuse. Paper pulp is to be prepared a pebble mill from waste paper collecte by the city. Chlorine, both for makin ferric chloride and for disinfection the final effluent, will be purchased.

Clarification of the screened sewag will take place in two circular precipita tion tanks 60 ft. in diameter and fro 8½ to 11 ft. deep. The sewage will ente each tank at the center, pass under circular baffle 7 ft. 2 in. in diameter an then flow radially outward to and up ward through the magnetite filter.

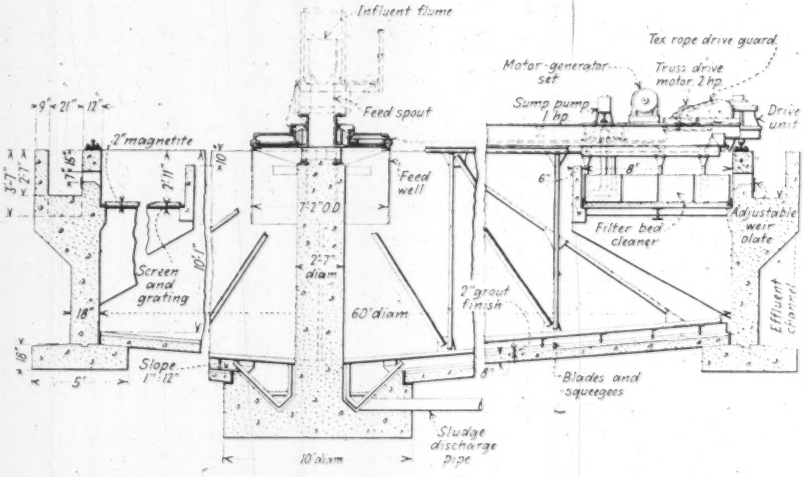
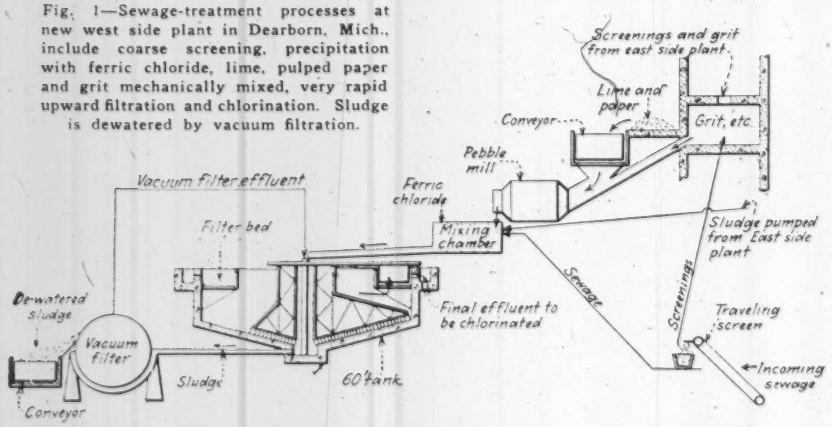


Fig. 2—Precipitation takes place in a circular tank equipped with revolving sludge scrapers. Partly clarified sewage passes upward through crushed and sized magnetite.

Mechanically operated scrapers are provided for sludge removal.

In plan, the filter bed is an annular ring occupying the outer 8 ft. of the top of the 60-ft. tank. The filter material is a 2-in. layer of crushed magnetite, supported by a phosphor bronze screen resting on concrete brackets built into the basin wall. A concrete curb resting on the outer ends of the brackets serves to keep the water in the basin from flowing over the top of the filter. When operating, there will be a 16-in. depth of sewage over the magnetite. The unusual filter material was selected primarily because of its weight, which will allow higher rates of upward filtration than would a lighter material such as sand. It is sized so as to pass a No. 10 sieve and be retained on a No. 16. The effluent passes from the top of the filters over a number of weirs set in rectangular openings in the outer wall into a circular effluent channel. The

Fig. 1—Sewage-treatment processes at new west side plant in Dearborn, Mich., include coarse screening, precipitation with ferric chloride, lime, pulped paper and grit mechanically mixed, very rapid upward filtration and chlorination. Sludge is dewatered by vacuum filtration.



rate of filtration is about 190 m.g. an acre.

The most unusual piece of equipment in the plant is the magnetic device for cleaning the filter. It is contained in a sector-shaped bronze cleaner case, 7 ft. 8 in. long and 4 ft. 6 in. wide at the outer edge of the basin, which is suspended just above the filter surface from the framing supporting the sludge scrapers. The top of the case is a few inches above the surface of the liquid. In the bottom there is a longitudinal opening over which is mounted a long bronze-inclosed solenoid wound about a vertical axis. The solenoid is as long as the cleaner case and about 18 in. wide, and it covers a narrow sector of the filter bed. As the cleaner case slowly traverses the filter, carried around on the

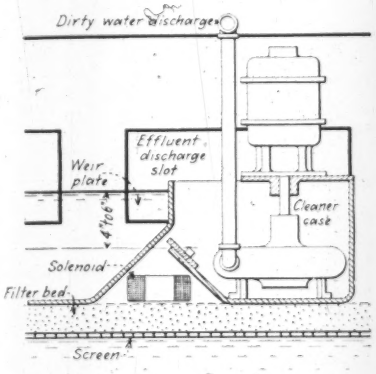


Fig. 3—Magnetite filter bed is cleaned by a traveling magnet, which lifts it from its supporting screen.

sludge-scraper framing, the solenoid is periodically energized by direct current. At those times the magnetic force lifts the filter material violently from its supporting screen into the space inclosed by the solenoid windings, thereby subjecting it to a rather severe stirring and washing by the sudden uprush of raw liquid from below. The dirty water drains off into the body of the cleaner case, from which it is pumped back into the basin influent.

The sludge drawn from the bottom of the clarification tank is piped to vacuum filters, where it is reduced to a relatively low moisture content. The dewatered sludge will have a high pulp content and will be entirely inoffensive, says Mr. Owen. Its ultimate disposal is still undecided.

Dissatisfaction on the part of Henry Ford, the man who pays the largest share of Dearborn's taxes, with the efficiency of the biological methods most frequently used in sewage treatment was the occasion for the development of the plant processes as described. Specifically, that dissatisfaction was given voice in his refusal to sell to the city the site for a proposed plant until the treatment processes to be employed met with his approval. Upon his examination of the plans for the present sewage-works, he

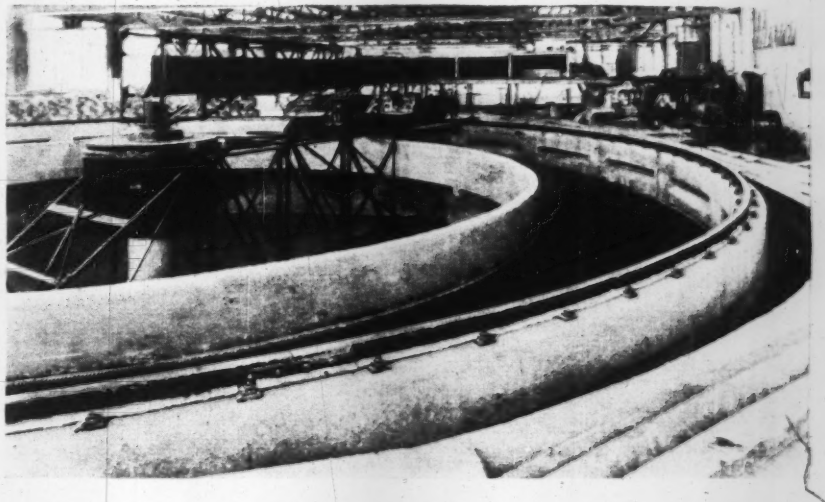


Fig. 4—In the combination precipitation tank and filter the latter occupies the area covering the steel gratings shown. The traveling magnetic filter cleaner can be seen at the far side of the tank, hung directly over the filter from the sludge-scraper framing. The flume at the top comprises the influent line.

expressed satisfaction and forthwith donated the site to the city. In the meanwhile, experimental work had been carried on for a year to develop a satisfactory process.

One phase of the experimental work concerned a new method of sludge disposal. The process involved the vacuum filtration of chemically precipitated sludge, its mixture with municipal garbage and its inoculation with a specific strain of bacteria. These bacteria had the property of digesting the material to a very small bulk, evolving sufficient heat in the process to evaporate most of the water. After a period of trial with unsatisfactory results it was decided not to use the process.

The new plant is admirably situated as far as delivery facilities are concerned. The site is a triangular plot of 16 acres, bounded by a main highway, the Detroit, Toledo & Ironton Railroad, and River Rouge. The natural slope of the ground is such that little excavation was required in the plant construction. There is ample room for the construction of an incinerator plant, should one be required.

The development of the treatment process and the special equipment was in the hands of W. C. Laughlin, of the Filtration Equipment Corp., and Mark B. Owen. Hubbell, Hartering and Roth designed the building's superstructure and the pumping facilities.

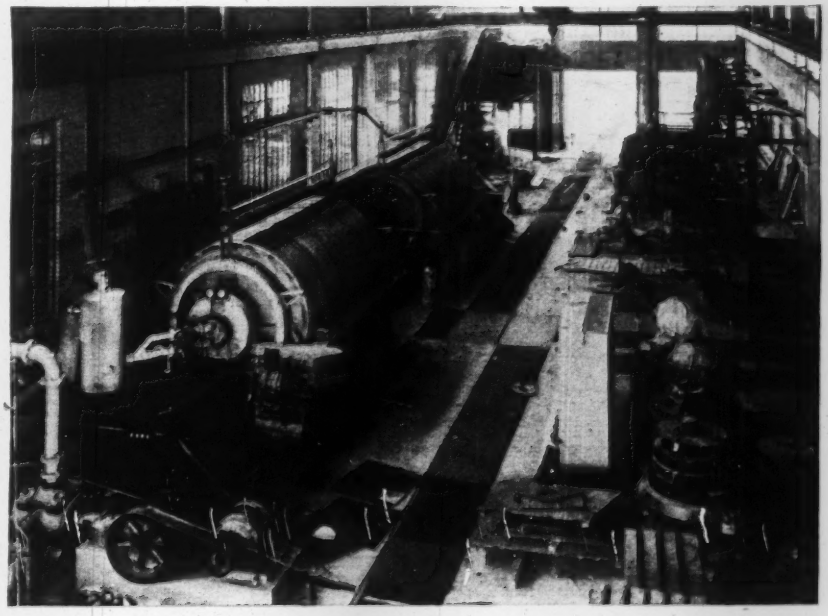


Fig. 5—Two vacuum filters are provided for dewatering the sludge from the precipitation tanks. In the right background can be seen the two pebble mills for making the pulped paper to be added to the tank influent.

Accurate Surveys Determine Sizes of Rival Big Trees

Survey shows "General Sherman," Sequoia National Park, to be largest living Sequoia gigantea, with volume of 50,010 cu.ft.—"General Grant" second

By J. W. Jourdan

Designing Engineer, San Joaquin Light & Power Corp., Fresno, Calif.

WITH a trunk volume of 50,010 cu.ft., "General Sherman" has been conceded to be the largest living *Sequoia gigantea*, as a result of a survey made to determine the relative sizes of several outstanding trees of this species in the Sierra Nevada ranges of central California. The survey resulted from the numerous requests received by local organizations for statistical information on these giant trees and the fact that available data were incomplete and inaccurate. The methods used were the result of careful study and were carried out with engineering accuracy, both as to field work and computations. It is thought that an outline of the procedure used, as well as the information on the size of these trees, would be of interest to many engineers.

Each tree was measured to determine its height with reference to a mean base and its restored volume, including the bark but exclusive of limbs. The restored volume was defined as existing volume plus the quantity lost by burns, the latter being practically confined to the base of the tree. The mean base was taken at the average elevation of the line of contact of the tree with the ground surface. Measurements were made of the perimeter at the ground and at several convenient heights above ground. Base diameters of a few of the principal limbs were also obtained. Because of their great size, climbing of the trees to secure measurements was out of the question and was prohibited by regulations in the case of the trees located in national parks.

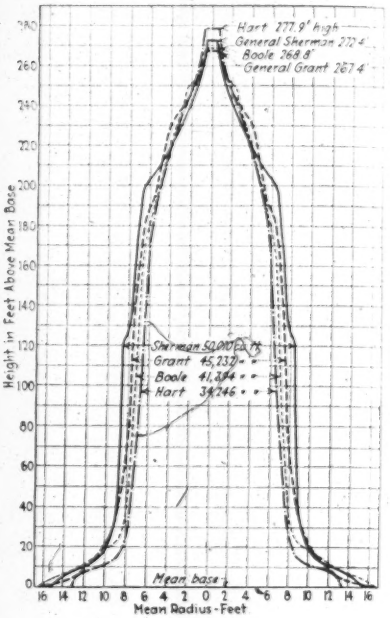


Fig. 2—Profiles of four of the great Sequoia trees.

Fig. 1—General Sherman (left) and General Grant, the two rival Sequoia trees. The former is the larger, with a record trunk volume of 50,010 cu.ft. and a height of 272.4 ft.

Field Work—Indirect methods of measurement based on principles of surveying were used, except for base perimeters and the burned-out portions of the trunks to heights of about 20 ft. The method consisted of making transit observations from a carefully measured and closed traverse with angle points located from 200 to 300 ft. from the tree, these points being chosen to give as clear a view of the tree as possible. A second traverse tied in to the main one was located close to the base of the tree for measuring the ground perimeter. Levels referring to a common datum were established for all points from which observations were made.

Each side of the main traverse was considered to be a base line. With the transit set up at one end of the line, both horizontal and vertical angular measurements were taken to a line-of-sight tangent to one side of the tree; then angles to the opposite side of the tree. This process was carried out from top of tree to the base. The transit was then moved to the other end of the line and the same procedure followed, care being taken to sight at same observed elevations. It was not always possible to take a complete set of observations along the trunk, but enough well-coordinated diameters were measured from the angle points of the traverse to insure sufficiently accurate results. The species of trees being measured is

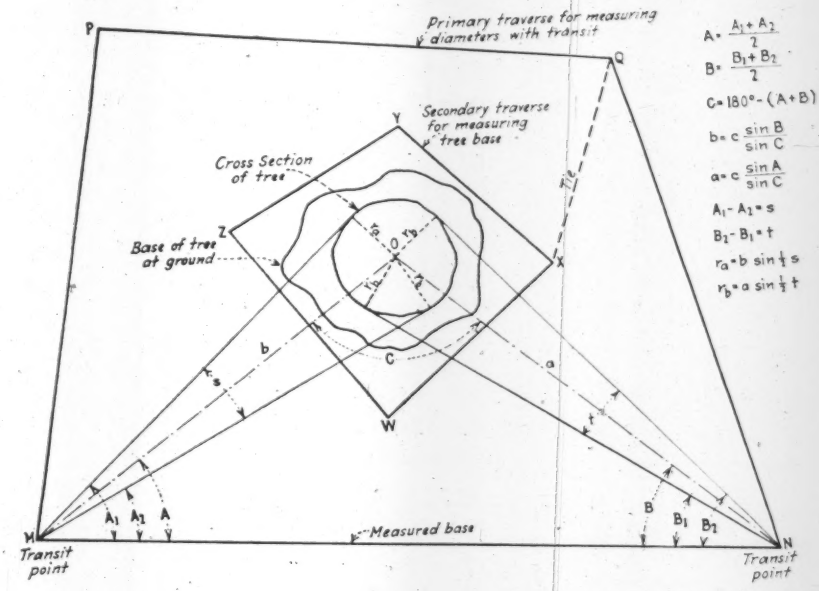

Primary traverse for measuring diameters with transit
Secondary traverse for measuring tree base
Cross Section of tree
Base of tree at ground
Measured base
Transit point
Transit point
A = (A1 + A2)/2
B = (B1 + B2)/2
C = 180° - (A+B)
b = c sin B / sin C
a = c sin A / sin C
A1 - A2 = s
B2 - B1 = t
ra = b sin ½ s
rb = a sin ½ t

Fig. 3—Diagram of method used to obtain measurements of mean diameters above ground.

only approximately circular in form, and it was necessary to know the variations of diameters to determine the cross-section area. Surrounding brush and smaller trees made field work very tedious.

Computations—Tree heights were measured from two or more set-ups and checked. The method of computing the mean tree diameter at various elevations is shown in the accompanying diagram. The groups of observations taken at approximately the same elevation were readily computed, and intermediate sights were adjusted and proved valuable in checking.

It is believed that the method used had the advantage of a constant control of errors. The diameters were obtained indirectly by angular measurement from a measured base line, with the result that observational errors were reflected in diameter as a very small percentage. For example, in taking observations from a point 300 ft. from the tree an error of 1 ft. in the computed distance would result in an error of only one-third of 1 per cent in measured diameter. As a final step, cross-sectional areas were computed from the mean diameters, and the volume was calculated by the prismoidal formula applied to sections of the trunk.

COMPARATIVE SIZES OF SEQUOIA TREES
(All measurements are in feet and cubic feet)

	Gen. Sherman	Gen. Grant	Boole	Hart
Height of top of trunk	272.4	267.4	268.8	277.9
Volume, excluding limbs	49,660	43,038	39,974	32,607
Volume of burns	350	2,194	1,420	1,639
Restored volume	50,010	45,232	41,394	34,246
Perimeter of base on slope	101.6	107.6	112.0	73.8
Perimeter (highest ground)	88.0	92.9	90.3	68.7
Mean diameter of restored base	30.7	33.3	33.2	26.5
Mean diameter at 60 ft.	17.5	16.3	15.3	14.5
Mean diameter at 120 ft.	17.0	15.0	13.9	12.9
Mean diameter at 180 ft.	14.0	12.9	11.9	11.3
Height to first live limb	99.7	83.8	....	...
Height to first large limb	129.9	129.8	126.0	...
Diameter first large limb	6.8	3.2	....	....

The accompanying tabulation of results shows a comparison of the principal features of the four trees measured. As a result of this expedition, considerable interest has been renewed in this subject, and the engineers responsible for the work are confident that the method described can be used as a reliable guide for future work of this kind.

The project was the result of the many inquiries made to the Fresno County Chamber of Commerce as to the actual size of these trees, and the work was undertaken by the junior division of that organization. The writer and J. G. Lewis, logging engineer, Sugar Pine Lumber Co., Fresno, were selected by their respective companies to cooperate in this work. Other engineers in the party were N. E. Beckwith, C. P. Jensen and J. G. Van Zandt.

Treated-Timber Economics Discussed at St. Louis

American Wood Preservers Association hears report on preservative treatment of timber

USE of timber treated by preservative processes continues to increase, and new uses were suggested at the annual meeting of the American Wood Preservers Association, at St. Louis. It was shown by J. S. McBride, chief engineer of the Chicago & Eastern Illinois Railroad, that after 32 years' experience this road has practically 100 per cent of its ties treated and 50 per cent tie-plated, with the result that annual renewals have been reduced from 300 to a little more than 100 per mile, or only 4 per cent of total ties in track, with an average life of 24½ years per tie. Both the zinc and creosoting processes are used.

Long and varied experience with creosoted timber in railway bridge work, with satisfactory results both technical and economic, was reported by the Atchison, Topeka & Santa Fe Railway System. R. A. Van Ness, bridge engineer, gave facts supplementing those reported ten years ago by the late A. F. Robinson, then bridge engineer of the railway (*EN-R*, April 13, 1922, p. 16).

Creosoting was first used by the Santa Fe in 1875, for treating the piles of the trestle crossing Galveston Bay. Although this structure, being in salt water, was subject to attack by limnoria and teredo, piles with a 10-lb. treatment lasted ten or twelve years, while those more heavily treated last for twenty years, or until the structure was renewed. This road now has plants of its own at Somerville, Tex.; Albuquerque, N. M., National City, Calif., and Wellington, Kan. Its timber-treatment was organized in 1904. The two oldest bridges of creosoted timber are mainline ballasted-deck structures built in 1899 and still good for ten or fifteen years, or a total life of about 40 years. Of 204 miles of bridges in 1931, about 48 per cent have ballasted decks of treated timber, and 90 per cent of pile bents are treated, while the latter figure will reach 100 per cent within twenty years. Treated stringers have been used within the past five years, and practically all open-deck bridges have treated ties. Thus the road is approaching a 100 per cent status as to treated bridge timber.

Bridge ties are now given an 8-lb. creosoting treatment by the Rueping process; southern pine bridge timbers get 14 lb., and Douglas fir is treated to refusal (about 13 lb.) after incising to give greater absorption. A mixture of 50 per cent creosote and 50 per cent petroleum is proposed, giving 16 lb. per

cubic feet for the pine and 13 lb. for the fir. Piles of southern pine and fir now get 16- and 13-lb. treatments of creosote, respectively, but the petroleum mixture is proposed with treatment to refusal for all piles, except that the amount is not to exceed 18 lb. This mixture has sufficient toxicity to prevent rot or fungus growth, and the viscous oil retards the evaporation of creosote, while the mixture treatment is expected to reduce season-checking in dry hot sections.

Tests of the effects of incising indicate a loss of only 8 per cent in strength in treated stringers due to the incising. This is not considered objectionable, since after 40 years' service the incised stringers will be in better condition and have greater strength than non-incised stringers having 4 or 5 lb. less of initial preservative.

It has been found on the Santa Fe that decay results from leaving piles in the woods before treatment and from cutting and boring treated timber. Piles are not now chamfered at the top, but when cut off and before the cap is placed the surface is sealed with creosote and heavy oil and covered with roofing paper nailed down on the side of the pile. Field holes and cut surfaces are swabbed with hot creosote. Since heavy driving of piles sometimes separated the heart from the sap wood, most of the driving is now done by double-acting steam hammers with a steel cap placed on the pile.

Framing of timber before treatment increasing

Boring and framing of timbers before treatment is rapidly increasing on the Santa Fe. In a recent trestle, about 1,000 ft. long, the frame bents, stringers, guard rails and ties were all framed and bored in advance. The same practice was followed for a pile trestle on a curve. In both cases only a few field holes were required in placing the deck.

Troubles with treated timber and with timbers bored and framed before treatment were reviewed as object lessons for the wood-preserving industry by N. R. Sack, bridge engineer of the Missouri state highway department. Treated timber was first used as a structural material in 1922, when several bridges were built with creosoted ties bolted to longitudinal steel beams and carrying a floor of creosoted planks laid parallel with the roadway. It soon became evident that a wearing surface was necessary to protect the planking. A bituminous mat coat was applied where traffic was light, or asphalt plank for heavier traffic, but this type of floor construction was superseded gradually by a reinforced-concrete floor. In 1928 treated material began to be used extensively, one important structure being a trestle 2,600 ft. long with 22,000 ft. of piling, 358,000 ft. b.m. of timber and a concrete floor. Such material is used also in guard rails, ditch checks and culverts.

Since the state has widely distributed deposits of sand and gravel for concrete, together with cement mills (while steel is relatively cheap), it would not be economical to ship timber from a distance for long-truss spans. On the other hand, treated timber is used extensively for substructure work, for bents supporting beam spans and occasionally for entire short spans. This material may be purchased by the contractor or by the department for its maintenance work, but difficulties are experienced in getting material that complies with the specifications as to quality and treatment, although these specifications are practically those of the timber and treating associations.

Whoever does the framing and boring, either at the mill or the treating plant, said Mr. Sack, should be sufficiently interested to see that it is done properly and accurately. It should not be necessary for the highway department to check every hole and cut. The various pieces should be clearly marked for identification in assembly. Incorrect framing or inadequate marking require field adjustment and alteration that may offset the expected economy in cost. Delays in furnishing material of the quality specified and rejection of material that does not comply with specifications cause much trouble and loss of time. In fact, said Mr. Sack, "Our experience in the cost of inspection of treated timber and piling is not a thing to which we can point with pride." In this respect, he stated that the timber-treating industry could take a lesson from the steel industry, where shop fabrication is similar to the boring and framing of timber. Each piece is shop-marked for the guidance of the erector in the field, so that even in difficult work on long spans each member fits exactly in its place as the plans indicate.

That improvement in these respects must result from the initiative of the wood-preserving industry was pointed out by Mr. Sack with the following conclusion. "You have a product to sell. Prepare it to the best of your ability, insist that its manufacture and treatment be such that the consumer will have full confidence in the material, and you will have done much to further the interests of your product."

Incising of ties before treatment does not affect seasoning

Incising of hardwood ties before air seasoning has no effect upon the rate of seasoning or the absorption and penetration of the preservative, but it may reduce checking, according to J. F. Harkon, chief of the wood-preservation division, Canadian Forest Products Laboratories. Bleeding and checking of pressure-treated poles was discussed by a committee, which considers bleeding as the result of hot-sun exposure with little geographical limitation. A lengthy report dealt with the methods and experiences of pole treatment by the American Telephone & Telegraph Co. Fence-post records were also presented at the meeting.

A wide field for treated timber in various miscellaneous ways was indicated by a committee, whose suggestions included foundation piling, wharf construction, grade-separation bridges and their decks, floors and roofs of buildings, mine timbers and ties, timber cribbing for walls, fence posts and sign posts, culverts, tanks and mattress protection for levees. Furthermore, present uses can be increased considerably.

Of similar but less definite character was a report on experiments with various chemicals as possible wood preservatives. Steaming periods for timbers of different sizes, preparatory to treatment, were reported on by J. D. MacLean, U. S. Forest Products Laboratory.

Inconclusive results obtained from termite tests

Results of some successful experience with treated piles as foundations for buildings was outlined by F. R. Judd, engineer of buildings, Illinois Central Railroad, who suggested that building codes should make a distinction between treated and untreated piles. New Orleans is one of the few cities in which this is done. This report will be abstracted in more detail in a future issue.

Tests of treated and untreated timber specimens placed in localities subject to attack by termites are not conclusive, even after three years, according to a progress report by George M. Hunt and T. E. Snyder, U. S. Department of Agriculture. These international tests have been made in the Panama Canal Zone, Hawaii, Australia and South Africa. Of sixteen preservatives four were 100 per cent good in the Canal Zone and Australia, five in South Africa and none in Hawaii. Furthermore, the preservatives have not given the same results at all stations. The report states explicity that "It is too early to assume that any of the preservatives give adequate protection or that the present relative standing of the various preservatives indicates their relative ability to protect wood against termites."

Marine piling was dealt with in a progress report.

A satisfactory financial condition and a membership of 734 were reported. Officers for 1932 include: president, E. T. Howson, western editor of *Railway Age*, Chicago; vice-presidents, R. S. Belcher, A., T. & S. F. Railway, Topeka, Kan., and S. R. Church, consulting chemist, New York; secretary (re-elected), H. L. Dawson, Washington, D. C. The 1933 convention is to be held at Chicago.

Brick Paving Interests Discuss Field Problems

Technical sessions of National Paving Brick Association with fifteen papers cover present-day problems of design, construction, inspection and finance

Engineering News-Record Staff Report

NEW DEVELOPMENTS in brick paving, replacement, relaying, salvaging and the financing of paving programs occupied the attention of the 150 delegates to the annual meeting of the National Paving Brick Association in Chicago Feb. 10, 11 and 12. Some comparatively new methods were reported, such as the use of whitewash on brick to permit the removal of the squeegee coat of surplus crack filler. Fillers and cushions seem yet to be the bone of contention. Financing of city paving has reached a point where the abutting property owners have gone on a strike and state that funds from the motorist must be returned to the cities if larger programs are to go ahead within municipalities, it was stated in the meetings.

A committee report on design and construction, presented by H. G. Sours, county engineer, Akron, Ohio, discussed best practice. For example, surface unevenness caused by cushion material filtering into base cracks has recently brought about considerable sentiment in favor of designing concrete bases with transverse and longitudinal joints providing for contraction and expansion. The contraction joints are usually of the weakened-plane type filled with bituminous material and covered with a strip of burlap; the expansion joints are of the open type sealed at the bottom with bituminous material and covered with a strip of light-gage metal. There has also been a rubber expansion joint developed that will re-expand after compression and will not extrude to any extent under compression. This design provides for crack control as well as stress in the slab, a matter which has been generally neglected in concrete-base design. Bases of this type have been constructed recently with satisfactory results in Summit and Stark counties, Ohio, Niagara County, N. Y., and several other places.

In 1930 an experimental section of metal base, 150 ft. in length, with a brick surface course, was installed near Springfield, Ill. (*ENR*, Oct. 2, 1930, p. 523). This construction proved to be weak structurally under a concentrated traffic test. The failure was partly due to the fact that stock sheets were used and spot-welded in place. Many of these welds were broken. When the section was removed in September, 1931, after being about a year in service, the sheets with corrugations placed lengthwise and the plain sheets did not have permanent deformations.

A present-day brick pavement is designed with a much thinner cushion course of uniform thickness than formerly. This is possible because modern specifications require the base course to be finished practically as smooth as the surface of the road. The bedding course should not be thicker than 1 in. and preferably ¾ in. Where resurfacing is done with brick, the old pavement used as a base is usually more or less uneven. Excessive variation in the surface of the old pavement may be corrected by leveling up with bituminous-binder material or by applying a slush coat of cement grout.

The filler now being used in practically all brick paving construction is a bituminous material. Portland cement grout, which was formerly used as a filler on all high-grade construction, is still required to some extent for special work, such as street-car tracks, gutters and parking strips. The grief encountered on account of unsatisfactory fillers has called for considerable study during the past two years. The most serious trouble has been bleeding of the filler during hot weather and slipperiness caused by some of the filler remaining on the surface.

Coating exposed faces

Some study has been made of coating the surface with certain materials that would prevent the adhesion of the filler. This coating has proved to be effective, but great care should be taken that none of the material creeps down along the sides of the brick and prevents adhesion where it is needed. The use of coarse grit (not sand) rolled into the surface immediately after application has been found to be of considerable value in preventing slipperiness, and it also peels off the surface satisfactorily. The tendency seems to be in favor of a harder filler; the soft fillers that have been used during recent years were to some extent the result of necessity brought about by the use of a lugless brick, which has now been largely discontinued. The harder fillers seem to hold their place satisfactorily, do not soften enough to cause any trouble, and they become sufficiently brittle during cold weather to permit the excess to chip off.

Prof. John S. Crandell, University of Illinois, chairman of the committee on fillers and bedding courses, related experiences with glycerine, water glass and whitewash to prevent crack filler from adhering to brick wearing surfaces. Water glass is satisfactory only if used full strength with a thinly spread filler. Attention was called to the necessity of handling emulsions carefully and in accordance with approved practice, else they may "break" unexpectedly. Spread over sand cushions they may not penetrate, break, and leave the asphalt on top. Further experiments are needed.

Resurfacing and relaying

Recently brick has been coming into its own as a resurfacing material. Some places have turned to brick to secure a new surface, while others have taken up the old brick and laid new on the old base. Meadville, Pa., has done both and has lifted old brick, shaped up the cushion, laid new 3-in. vertical fiber brick, asphalt-filled and rolled them for from $1.63 to $1.75 per square yard on different jobs. This figured no salvage and was done at the time of peak prices with city forces. While brick resurfacing is desirable in all cities, it is really a life saver for the small municipality with small jobs to do and no asphalt plant, said R. L. Phillips, city engineer of Meadville. Practically all of the job is hand labor, and any size job can be undertaken. The small city can resurface its streets with brick as the money becomes available and do the entire job with a few tools and local labor.

As a means of caring for unemployment, Albany, Ga., a small city in an agricultural section, has been relaying vitrified paving laid in 1905 with 3x4x8-in. brick on a 56-ft. street 1,800 ft. long between several cotton warehouses and a compress. This work was chosen, according to C. Q. Wright, city manager, because of the high percentage of the cost going to labor. New paving was estimated at but 25 per cent for labor, and sewers at an even lower percentage. In taking up the brick, twenty men and a foreman were used. It was found that after the first row it was just a matter of loosening the others, one row at a time, with a crowbar, and carrying it in brick tongs to the sidewalk. The sidewalk was 14 ft. in width, and the brick pile was made so as to allow only a 5-ft. walk. This left sufficient room between the outside of the stack and the curb so that the cleaning could be done on the street side away from the pedestrians and the brick re-stacked as cleaned next to the curb. Except in

cleaning up the street, it was not necessary to truck a single brick on the job.

In cleaning the brick a crew of varying number was used. From $2.50 to $3 per thousand was paid. Each man was required to stack his brick in one place, or to mark the division between his and his neighbor's pile. The city furnished leaves from old automobile springs to hack off the tar. Many of the workmen preferred to use instruments of their own furnishing, some using small hatchets and others large butcher knives. A good workman could clean from 500 to 600 a day.

Immediately upon completing the cleaning on a half block, relaying began. From this point on the job was carried out as new brick surfacing, except that it was necessary to check and recheck the surface much more carefully, taking out the chipped and badly worn brick. The worn ones were not thrown out but were shoved on ahead until there was accumulated enough for four rows, when they were relaid.

Only a small amount of equipment was necessary. In addition to the customary small tools, there were used four dozen brick tongs, a small roller made of 15-in. cast-iron pipe filled with concrete for the sand cushion, a 300-gal. oil-burning asphalt kettle, a 7-ton tandem roller, four squeegees for pulling the asphalt into the joints and a half-dozen asphalt-pouring pots. The only material bought was asphalt. At the low prices paid (brick dropper, $5; sand-cushion man, $4; all others, $1.25) the finished job cost but 50.8c. per square yard, not giving any credit for the 17,000 bricks left over by reason of laying with the wide side up. Labor cost 34.5c. and material and equipment, 16.3c. per yard.

Other low-cost resurfacing

Chillicothe, Ohio, is another small city that relaid a brick pavement in 1931. The contract price of relaying the brick was 88c. per square yard, which included cleaning, a new sand bed, relaying and an asphalt filler. From 3,533 sq.yd. of old brick pavement, 2,900 sq.yd. of relaid pavement was constructed; several loads of brick were stored to be used for patching. This is a reclamation of 82 per cent.

The third replacement of paving, on the Washington St. Memorial Bridge over the Brandywine in Wilmington, Del., was with 3-in. vitrified brick on a 4-in. tar-sand cushion compacted to 2½ in. and filled with asphalt. Longitudinal alignment of joints in the herringbone pattern on the 12-ft. drives on either side of the car tracks was obtained by nails in the bottom of the cushion screed.

Alban P. Shaw, New Castle County engineer, explained how exposed surfaces of brick were whitewashed to prevent the asphalt filler, applied by squeegees, from adhering. After the first coat of asphalt had set, a second coat was applied to fill in all the settled joints. In 15 min. the asphalt could be readily removed in sheets with scrapers from the surface of the bricks, which were soon cleaned of the whitewash either by rain or by traffic. The asphalt that was scraped from the surface was found upon analysis to contain less than 0.1 per cent of lime, and while that amount would not affect the ductility of the asphalt, the continued repetition of the use of the waste would build up the lime content to such an extent that the filler would be too hard and brittle. Therefore the waste was limited in use to 50 per cent of the old to 50 per cent of new asphalt, and the remaining used asphalt was removed from the job.

Illinois resurfacing with brick

Last year the Illinois division of highways resurfaced 60 miles of concrete with brick and widened old 16- and 18-ft. slabs to a uniform width of 20 ft. C. M. Hathaway, engineer of construction, detailed the design and procedure, some of which is noted below.

The design adopted followed a theory that had been applied in several cases where it had been necessary to widen old concrete pavements—that is, undercutting the old pavement for a distance of 12 in. and pouring concrete to a depth of 6 in. under the old slab. Thus the edge of the old pavement was strengthened to handle the loadings anticipated. In the case of the brick resurfacing it was also necessary to provide a concrete curb to serve as a retainer for the brick.

The second problem was that of replacement of portions of defective pavement, and this was done by providing a "patch" of new concrete of the same thickness as the old concrete on any portions which had reached a state of practical failure and which could not be depended upon as a satisfactory base—this applied to old bituminous patches and existing corner and center breaks. Contraction and other temperature cracks were cleaned out and filled with bituminous material or new concrete. In a few cases, where dangerous cracks had developed, they were torn out for their entire length and new concrete patches poured.

Trouble developed in forcing the concrete underneath the old pavement, particularly on the old 18-ft. sections, because it was difficult to get a spading tool between the forms and underneath the pavement. It was necessary to use concrete with a slump of 3 to 4 in., and the operation required careful placing and continual inspection.

E. J. Fraser, McCarthy Improvement Co., Davenport, Ia., in discussion detailed the method of undercutting. A two-bladed plow was used, adjustable so as to cut about 3 in. each trip. Later a cleaner, to scrape the underside of the paving was added. The big job w the training of the help after the to was perfected. Leaving the dirt in t trench until the form line was set grade was found necessary to keep t undercutter snug under the edge of t pavement. The tool weighed 800 l It was difficult to handle until a sma hand winch was put on the back of th tractor to pick up the tool. The under cutting was then done with a tracto operator and one man.

Financing municipal paving

Pere S. Seward, executive engineer American Road Builders Association opened a discussion on financing municipal paving, in which he stressed the growing difficulties of putting through special assessment work because of the greater general public use of the roadway. Only dead-end streets are local any more. More and better distribution of the motorists' contribution in the cities was stressed. Mr. Seward argued for the classification of roads according to the method of paying for them, such as all by abutting property, city and county to share equally, or city, county and state to share cost.

William N. Carey, chief engineer, department of public works, St. Paul, Minn., in his discussion of the subject, stated that before the city property owner may obtain more pavement for his money than he does now, three principal objectives must be achieved:

First, a less arbitrary and more equitable means must be adopted for determining special assessments. At present the cost of paving in cities is largely assessed against the abutting property on either a front-foot basis or in accordance with the estimated benefit derived. The latter method is more equitable but should be limited to the cost of a 36-ft. width. For wider streets the excess width should be paid for by the city at large, the county or the state. Intersection paving, likewise, should be assessed against the community.

Second, cheap secondary types of paving should be developed and adopted where economically justified. Maintenance should be charged to the abutting property, and when they become too high the pavement should be replaced by one with a high-class surface. With proper planning the old pavement can then be used as a base for the new.

Third, a reapportionment should be made of the gasoline-tax money so that cities may receive a fair share of the taxes paid by their residents. At present only Ohio and Michigan give the cities a fair share of this tax collection. In Minnesota, since 1921, 40 per cent of the gasoline tax has been provided by St. Paul, Minneapolis and Duluth, but these cities have received none of it at all to use for city streets.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

British Report on Design of Steel Structures

REVIEWED BY ROBINS FLEMING
American Bridge Co., New York City

STEEL STRUCTURES RESEARCH COMMITTEE (First Report) of the [British] Department of Scientific and Industrial Research. Paper; 6x10 in.; pp. 276; line cuts and halftones. 5 shillings plus postage from H. M. Stationery Office, London; $1.30 plus postage from British Library of Information, 270 Madison Ave., New York City.

SELDOM has a report been presented either in this country or in Europe that contains more information of interest and value to the structural engineer than the first report of the steel structures research committee of the British department of scientific and industrial research. The committee was appointed for five years, starting from August, 1929, to review present methods and regulations for the design of steel structures and has produced a well-illustrated volume of valuable information. It could hardly be otherwise with the eminent names connected therewith. As Stanley Baldwin says in the preface: "It is an encouraging feature of modern civilization that, whenever the cause so requires, there are forthcoming men of the highest ability who are ready to give freely of their services, without thought of reward."

The items selected by the committee for examination were: loads on floors; strains in buildings; stress analysis; specifications and properties of the materials; welded connections; vibrations.

Preliminary to detailed consideration of these items 30 pp. are devoted to a comparison of the regulations governing the design of steel frame buildings in London, New York, Germany, Spain and Belgium, together with provincial cities of Great Britain and Ireland and also of the dominions—Canada and Australia in particular. The report is full of research work on structural steel problems—Prof. Batho on riveted and bolted joints may be cited.

The practicing engineer will be specially interested in the recommendations for a code of practice filling nearly 20 pp. Superimposed floor loads are greatly reduced from the present London Building Act; for example, floors for domestic purposes, hotel bedrooms and the like are recommended to be designed for 40 instead of 70 lb. per sq.ft. and the upper floors of offices for 50 instead of 100 lb.

Wind loads are always a subject of interest. The present London act calls for 30 lb. per sq.ft. on the upper two-thirds of an exposed surface. The new report recommends that 15 lb. be used on the upper two-thirds of an exposed surface with an additional pressure of 10 lb. per sq.ft. upon all projections above the general roof level. On the seacoast and in similarly exposed locations a further provision not exceeding 10 lb. per sq.ft. is stipulated. If the height of a building is less than twice its average width, wind pressure may be neglected, provided the building is adequately stiffened by floors and walls. It should be remembered that the American skyscraper is unknown in London. The height of buildings is limited to 80 ft., ecclesiastical structures excepted.

Working stresses allowed in tons (2,240 lb.) per sq.in. are:

Parts in tension, axial stress (net section)	8
Extreme fiber stress in beams, tension	8
Compression flanges of beams, laterally secured	8
Shearing stress of webs, gross section	5
Shearing stress of shop rivets	6
Shearing stress of field rivets	5
Bearing value of shop rivets	12
Bearing value of field rivets	10

The column formula used is quite complex. The tabular values given for l/r from 20 to 240 are 7.2 to 0.9 tons per sq.in. For 50 l/r it is 6.0; for 70 l/r 5.4; for 100 l/r, 3.8; for 120 l/r it is 2.9.

An increase of 33⅓ per cent is permitted throughout for working stresses due to wind loads.

Earthquake Studies for the Engineer

REVIEWED by N. H. HECK,
Chief Division of Terrestrial Magnetism and Seismology, U. S. Coast & Geodetic Survey, Washington, D. C.

EARTHQUAKE DAMAGE AND EARTHQUAKE INSURANCE: Studies of a Rational Basis for Earthquake Insurance; also Studies of Engineering Data for Earthquake-Resisting Construction—By John Ripley Freeman, Engineer; President Manufacturers' Mutual Fire Insurance Co., Past-President American Society of Mechanical Engineers, Past-President American Society of Civil Engineers. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 904; many halftones and line cuts, some on folding plates. $7.

THE earthquake at Santiago, Cuba, on Feb. 3, 1932, emphasizes the timeliness of Mr. Freeman's stimulating contribution to earthquake literature. It is the first publication that has been entirely devoted to earthquake damage and earthquake insurance for particular use in insurance and construction.

In a monumental work of 900 pages the author sets forth his views on these subjects and presents evidence from many sources to bear them out. Briefly, his viewpoint is that no part of the United States and Canada can be considered exempt from earthquakes, and that nevertheless the present situation regarding earthquake insurance is largely on an unsound basis, due to lack of knowledge. In most known earthquakes, even the more severe ones, damage has been confined to relatively small areas and destruction mainly to poorly constructed buildings.

Much evidence is introduced to show that for the region east of the Rocky Mountains insurance could cover both fire and earthquake without additional cost, since on the average only one earthquake per century need be expected that will do more than throw down chimneys and do minor damage to buildings. On the Pacific Coast the probabilities for any region are for severe earthquakes at twenty- to fifty-year intervals. Even here, however, the rates could be much reduced if good construction were more universal and risks were widely distributed.

There is need for more scientific work on this problem, and only recently have those engaged in the new science of seismology taken cognizance of the engineer's requirements. The author is somewhat critical of the seismologist for this neglect, but it should be pointed out that it is only through the attack of the seismologist on the problem of the transmission of earthquake waves from a distance that he is able, by developing suitable instruments and interpreting their records, to meet the demand of the engineer for accurate measurements of earth movements in the central region of a severe earthquake.

To reinforce his conclusions regarding earthquake risk and the propriety of the suggested basis for insurance both for the region east of the Rocky Mountains and for the Pacific Coast region the author describes scores of earthquakes. He also gives a résumé of the important earthquakes in many other parts of the earth and also of developments in seismology. This comprehensive collection of material will for a long time to come serve as a rich mine of information, especially to engineers.

Much emphasis is laid on Japanese investigations, since through the pressure of stern necessity that country has been made the field of intensive earthquake study. In fact, Japan was the birthplace of modern instrumental seismology through the work of visiting professors during the earlier days, work that has been ably carried on and expanded by the Japanese scientists. They have utilized to great advantage the

large amount of material afforded them to work on—probably more than for any densely populated area of similar extent to be found anywhere else. Special attention is given to the work of the Earthquake Research Institute of Japan, which deals directly with earthquake problems from the viewpoint of the engineer.

A study of the situation in Italy resulting from changed policies regarding construction after the Messina earthquake is given. The new codes have many valuable features.

Tests of models of buildings and structures on shaking platforms, such as are being carried out at Stanford University, California, is a most promising development. Further facilities for this work should be provided so that models of different scales may be tested to be sure that they truly represent the structure.

In addition to the important public service of calling the attention of engineers and insurance men to this material, the author has expressed his views in regard to a comprehensive program chiefly through existing agencies and supported from time to time with moderate grants for specific purposes.

Some of the things recommended were accomplished while the volume was in press. Thanks to the initiative of the author and the American Society of Civil Engineers, Prof. K. Suyehiro, director of the Earthquake Research Institute of Japan, has recently visited this country and given a series of lectures that have helped to clarify and direct our ideas. Through the joint activity of the Bureau of Standards, the Coast and Geodetic Survey and the Massachusetts Institute of Technology accelerometers and displacement meters capable of recording strong motions have been developed and will soon be installed by the Coast and Geodetic Survey in the Pacific Coast region.

Mr. Freeman recommends the study of earthquake damage to buildings immediately after the earthquake, more comprehensive study of the geological features of earthquakes, installation of tilt meters to study the tilting of the ground (as is done in Japan, where in some cases such tilting has proved to be the immediate percursor of an earthquake), setting of straight monumented reference lines, study of soil characteristics through models, and many other things. With these investigations and others which may develop as the experiments go along, it is reasonable to hope that the public, the insurance men and engineers will become so well informed that they will be better able to deal with earthquake problems and will be able to prevent damage from moderately severe earthquakes and greatly curtail that from those of great severity.

The author, while cautioning people against acting from fright rather than common sense, nowhere belittles the problem. He evidently appreciates the difficulties involved in coordinating the activities of the necessary agencies and in interpreting the results. He has contributed largely to an effective start of the work, and even though his book appears at a time when obtaining the necessary funds for investigation is more difficult than for many years past there is little doubt that the excellent foundation will be built upon. His efforts constitute a real public service and will undoubtedly lead to results of much economic and humanitarian value.

Waterproofing Practice

GRUNDWASSER-ABDICHTUNG: Darstellung aus der Praxis—Von Dr.-Ing. Joachim Schultze. Dritte Auflage, neubearbeitet von Dr.-Ing. Willy Sichardt. Paper; 6x9 in.; pp. 69; line cuts and halftones. 5 marks.

DR. SICHARDT has brought up to date Dr. Schultze's German treatise on masonry waterproofing. No material alteration has been made in the organization of the material, but the progress made in waterproofing technique and the development of new products has necessitated some little expansion. For example, there has now been included a discussion of admixtures of a chemical nature. The number of illustrations has been increased and added examples of practice are given, especially in the use of asphaltic materials.

American Book and German Booklet on Dams

REVIEWED BY JAMES P. GROWDEN,
Assistant Chief Engineer, Aluminum Company of America, Pittsburgh, Pa.

THE DESIGN OF DAMS—By Frank W. Hanna, C.E., M.Am.Soc.C.E., Chief Engineer and General Manager, and Robert C. Kennedy, C.E., M.Am.Soc.C.E., Chief Designing Engineer, East Bay Municipal Utility District. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 456; 87 illustrations, mostly line cuts. $5.

TALSPERREN—Von Dr.-Ing. N. Kelen, Privatdozent an der Technischen Hochschule Berlin. Berlin and Leipzig: Walter de Gruyter & Co. Linen; 4x6 in.; pp. 143; tables, line cuts and halftones. 1.8 marks.

THE authors of "The Design of Dams" have drawn on their very extensive experience for the material incorporated in their treatise on the design of all types of dams.

In their professional work the authors have studied and solved the problems encountered in many different types of water storage and utilization. In some instance the commonly accepted methods of analysis failed to give entirely satisfactory results, which has led the authors to develop original formulas, particularly for stress analysis of arch, multiple arch and straight and curved gravity dams. The methods presented not only are mathematically exact but can be practically applied. In this respect the book differs favorably from many others, which are often a mere compilation of commonly accepted formulas or a purely theoretical treatment of the subject entirely divorced from practical design.

For the designing engineer, the book treats fully all phases of a water utilization study. There are chapters on surveys and quality of water; rainfall and streamflow; selection of type of dam; and foundations.

The next five chapters analyze the forces acting on a gravity dam, including uplift and earthquakes, and discuss straight and curved gravity dams. The criteria which must be satisfied to produce a stable structure and the theoretical and practical methods to satisfy them are clearly set forth. Overflow and non-overflow dams are treated and illustrated by a complete analysis of existing structures. Spillways are particularly well handled.

After a chapter on deck dams, the authors take up general theory and detailed design of arch dams by the Hanna method of arch-dam analysis—a very ingenious and compartively simple method. The trial load method of arch-dam analysis as developed by the U. S. Bureau of Reclamation is briefly mentioned, as is the use of models in arch-dam design. These discussions fill seven chapters; then come a chapter each on multiple-arch, rockfill and earth dams, the latter meriting particular attention.

Accessories for dams, including independent spillways, reservoir outlets, valves, crest gates and flashboards, are adequately reviewed in a separate chapter. In Chap. XXII weirs, orifices, current meters and other methods of water measurement are treated, as also flow in open channels, backwater curves and the hydraulic jump. The final chapter records a few of the more important dam failures and briefly discusses their probable cause.

Time-saving methods of calculation are fully illustrated in the book. Numerous tabulations present a large variety and amount of information in a very small space. The maximum discharge records appear unnecessarily complete. The student is given a complete picture of every step in the development of water resources. For his benefit all equations are rigorously derived, while the equations required for design are printed in bold type so that the busy designer need not work out the preliminary steps.

While it is unlikely that the practicing engineer will agree that all of the methods of analysis are perfect, the complete and comprehensive treatment of the entire subject and the practical utility of the solutions offered combine to make a book of such outstanding value that no engineer engaged in the design of any type of dam can afford to be unacquainted with its contents.

Dr.-Ing. N. Kelen's "Talsperren," a German booket of 143 pp., pictures in a general way the present status of the

design and construction of all types of dams (gravity, arch, multiple-arch, Ambursen, multiple-dome, rockfill and earthfill) and lists the pertinent data from the important dams in many different countries. Not only are conventional types described but many novel designs are discussed. Spillways, penstock valves, gates and other appurtenant features of dams are dealt with. The author is to be congratulated on condensing such a large amount of information in such a brief space. The book well warrants an English translation.

Many Cures and One Cure

THE ABOLITION OF POVERTY—By Harrison E. Fryberger. New York: Advance Publishing Co. Cloth; 5x8 in.; pp. 152; tables. $1.50.

WAGES AND THE ROAD AHEAD—By James D. Mooney, Co-author of "Onward Industry!" New York, London: Longmans, Green & Co., Cloth; 5x8 in.; pp. 149. $2.

AMORE "equitable distribution of wealth" is Mr. Fryberger's plan for abolishing poverty. In a number of short, readable chapters he presents data and arguments designed to show the great extent to which capital is concentrated in a few hands, the resulting evils, and ways and means for capital redistribution. He attacks the chain store, the merger of corporations, the East's "exploitation of the South and West" through the tariff and freight rates. One chapter is entitled "Equality of Opportunity." He supports farm relief and prohibition, advocates disarmament, increase of the income tax in the higher brackets and inheritance taxes and "an American five-year plan."

In "Wages and the Road Ahead" Mr. Mooney urges deflation of wages, particularly in the building trades, and a general reduction in prices and profits, both as a means of increasing production and wealth. He claims that housing for the masses of the people is grossly inadequate and unsatisfactory and that good housing is way beyond the incomes of most people. This he believes is largely due to the high prices of labor in the building trades, which raise costs of good housing beyond what even union laborers themselves can afford. He draws an interesting parallel between the automobile and the building industries, attributing the low cost of cars not only to standardization and mass production but also to low wages, compared with those in the building industry. The author gives hearty credit to help from Otis Peabody Swift, "particularly in illuminating and making graphic what after all are only a few old-fashioned truths." Quite regardless of whoever is responsible for it, the ideas expressed in the book are brilliantly expressed, making the reading of the book a pleasurable way of spending an hour or two profitably.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

ADVANCED MECHANICS OF MATERIALS—By Fred B. Seely, M.S., Professor of Theoretical and Applied Mechanics, University of Illinois. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 331; line cuts. $5.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS GUIDE, 1932. Flexible; 6x9 in.; pp. 876; tables, graphs and line cuts. $5 from American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York City.

Besides society membership roll and transactions and many technical data, has a manufacturers' catalog data section. Both catalog and technical data are indexed in detail. Five chapters have been added to this issue, which is the tenth, and the data given before have been revised.

THE BUILDING OF THE CITY: Regional Plan, Vol. II—By Thomas Adams, Assisted by Harold M. Lewis and Lawrence M. Orton. New York City: Regional Plan of New York and Its Environs. Cloth; 9x12 in.; pp. 660; maps, diagrams and halftones. $25 for this and the other "plan volume." $3 each for eight "survey volumes"; $50 for the entire ten volumes and a copy of the "graphic plan" for mounting.

CENTRAL HEATING AND HOT WATER SUPPLY FOR PRIVATE HOUSES—By G. C. Sanford, A.M.I.M.E. London: Crosby Lockwood & Son. Cloth; 5x7 in.; pp. 172; line cuts and tables. 8/6.

A short elementary well-illustrated review of the subject indicated by the title.

COMMUNITY PLANNING FOR HOMELESS MEN AND BOYS: The Experience of Sixteen Cities in the Winter of 1930-31—By Robert S. Wilson, Special Research Assistant, Family Welfare Association of America. Paper; 6x9 in.; pp. 144; Copies can be obtained from the Family Welfare Association of America, 130 East 22d St., New York City. 50c. each; in quantity, ten copies, $4; 25 copies, $9.

CONTROL OF FLOODS in the Alluvial Valley of the Lower Mississippi River: Report from the Chief of Engineers, U. S. A., on Review of Existing Projects for Flood Control and Navigation of the Mississippi River in Its Alluvial Valley as shown by public document 391, 70th Congress, 3d session. Paper; 6x9 in.; pp. 451; tables, maps and halftones, including many illustrations on folding plates. Apply to Congressman or to Chief of Engineers.

Besides brief reports by Major Gen. Lytle Brown, Chief of Engineers, U. S. A., the Board of Engineers for Rivers and Harbors (submitted by Col. Herbert Deakyne), the Mississippi River Commission, and Brig. Gen. T. H. Jackson, contains a vast mass of fully illustrated material on control of floods in the lower Mississippi Valley. Four of the sections are directed to the hydraulics of the New Madrid floodway, the Bonnet Carré spillway and the Atchafalaya and Boeuf basins.

DER SCHNITTVORGANG IM SANDE—Von Dr.-Ing. Johannes Rathje. Berlin N. W. 7: VDI-Verlag G.M.B.H. Paper; 8x12 in.; pp. 24; photographs and line drawings. 5 marks.

FACTORIES IN ENGLAND: A Wellwyn Book—Paper; 10x13 in.; pp. 30; illustrated. Free on request from Wellwyn Garden City Information Bureau, Wellwyn, England.

Sets forth the factory-site advantages offered by this well-known garden city and gives information about some of the industrial plants already located there.

THE HETCH HETCHY WATER SUPPLY AND POWER PROJECT of San Francisco—M. M. O'Shaughnessy, M.Am.Soc. C.E., City Engineer. Paper; 6x9 in.; pp. 64, illustrations and line cuts. For copies apply to Mr. O'Shaughnessy (now consulting engineer on the project).

Describes to Nov. 31, 1931, the dam, power plants, aqueduct and accessories of this great engineering work for the water supply of San Francisco and the associated hydro-electric developments. Mr. O'Shaughnessy credits L. B. Cheminant, assistant engineer, for the preparation of the booklet.

HISTORY AND THEORY OF AGRICULTURAL CREDIT IN THE UNITED STATES—By Earl Sylvester Sparks, Ph.D., Dean of the College of Arts and Sciences, Director of the School of Business Administration, Professor of Economics, University of South Dakota. With foreword by Thomas N. Carver, Ph.D., LL.D., Professor of Political Economy, Harvard University. New York: Thomas Y. Crowell Co. Cloth; 6x9 in.; pp. 476. $3.75.

AN INVESTIGATION OF THE CONSTITUTION OF PORTLAND CEMENT and Properties of Cement Components With Relation to Disintegration of Concrete—By R. J. Colony, Associate Professor of Geology, Columbia University, and D. L. Snader, Research Fellow, Columbia University, Professor of Civil Engineering, Stevens Institute of Technology. Bulletin No. 4, Civil Engineering Testing Laboratories, Columbia University, New York City. Paper; 6x9 in.; pp. 122; illustrations. 50c.

KEEP MOVING—By Alfred C. B. Fletcher. Chicago: Laidlaw Brothers, 320 East 21st St. Cloth; 6x9 in.; pp. 279; 56 woodcuts by Gregory Orloff. $2.50.

LUXURY TAXATION AND ITS PLACE IN A SYSTEM OF PUBLIC REVENUES—By Ralph Burnett Tower—Special Report No. 4, New York State Tax Commission, Albany, N. Y. Paper; 6x9 in.; pp. 235.

MEASURING WATER IN IRRIGATION CHANNELS—By R. L. Parshall, Senior Irrigation Engineer, Division of Irrigation, Bureau of Agricultural Engineering. Farmers' Bulletin 1683, U. S. Department of Agriculture. Paper; 6x9 in.; pp. 18; tables and seven line cuts. 5c. from Superintendent of Documents, Washington, D. C.

Gives particular attention to the Parshall measuring flume with converging and diverging throats.

MOVEMENT OF PIERS DURING THE CONSTRUCTION OF MULTIPLE-SPAN REINFORCED-CONCRETE ARCH BRIDGES—By Wilbur M. Wilson. Paper; 6x9 in.; pp. 30; line cuts. 20c. from Engineering Experiment Station, Urbana, Ill.

THE NILE BASIN—By H. E. Hurst, M.A., D.Sc., F.Inst.P., Director-General, Physical Department, and P. Phillips, D.Sc., B.A., F.Inst.P., Director, Hydrological Service, Physical Department. Vol. I: General Description of the Basin, Meteorology, Topography of the White Nile Basin. Physical Department Paper No. 26, Egyptian Ministry of Public Works. Boards, ¾ cloth; 8x11 in.; pp. 141; over 120 maps, diagrams and halftones as plates, many folding. 50 P.T. from Government Press, Bulaq, Cairo, Egypt.

A well-written handsomely made volume covering the details indicated by the subtitle.

OHIO PUBLIC UTILITY RATE BOOK: Part I, Water Rates and Services—Compiled and Verified by Ellsworth Wolfsperger and Rex N. Johnson. Columbus, Ohio: Ohio Municipal League, Ohio State University. Paper; 6x9 in.; pp. 47. $3.

More comprehensive than title indicates. Besides water and sewerage rates gives ownership, date built, valuation, source, treatment, pumping plants, house connections, meters, a little information about sewerage, funded debt, etc. Contains reports from the 110 cities and many of the larger villages of Ohio.

THE PORT OF DETROIT, MICHIGAN—Prepared by the Board of Engineers for Rivers and Harbors, War Department, in cooperation with Bureau of Operations, U. S. Shipping Board. Paper; 6x9 in.; pp. 122; tables and folding maps. 45c. from Superintendent of Documents, Washington, D. C.

POWER ETHICS: An Analysis of the Activities of the Public Utilities in the United States, Based on a Study of the U. S. Federal Trade Commission Records—By Jack Levin, Research Staff, People's Legislative Service, Washington, D. C. Introduction by Dr. John H. Gray, Head of the Department of Economics, Graduate School of the American University.

Past-President of the American Economic Association. Former Chief Analyst and Examiner, Interstate Commerce Commission Bureau of Valuation. New York: Alfred A. Knopf. Cloth; 5x8 in.; pp. 191. $2.

POWER AND THE PUBLIC—Edited by Ernest Minor Patterson, Ph.D. Professor of Economics, University of Pennsylvania; President of the American Academy of Political and Social Science. Philadelphia: The American Academy of Political and Social Science, 3457 Walnut St. Cloth; 6x9 in.; pp. 189. $2.50, or unbound, $2.

SETTING UP A PROGRAM OF RELIEF—By Joanna C. Colcord, Director, Charity Organization Department, Russell Sage Foundation. New York: Russell Sage Foundation, 130 East 22d St. Paper; 6x9 in.; pp. 23. 25c.

SMOKE AND ITS PREVENTION—By H. M. Faust, Research Engineer. Paper; 6x9 in.; pp. 15; illustrations. Free from Engineering Experiment Station, Ohio State University, Columbus.

STRENGTH OF CONCRETE BLOCK PILASTERS UNDER VARIED ECCENTRIC LOADING: Investigation in Cooperation with the Common Brick Manufacturers' Association of America—By J. R. Shank and H. D. Foster. Paper; 6x9 in.; pp. 35; halftones, tables and line cuts. 50c. from Engineering Experiment Station, Columbus, Ohio.

SURFACE WATERS OF TENNESSEE: With a Chapter on Flood Conditions for Rivers other than the Mississippi. By Warren R. King. Prepared in cooperation with the United States Geological Survey and the Corps of Engineers, U. S. A. Paper; 6x9 in.; pp. 165; photographs, tables and line cuts. Nashville, Tenn.: Division of Geology, State Department of Education.

A TEXTBOOK OF PRACTICAL ASTRONOMY: Primarily for Engineering Students—By Jason John Nassau, Professor of Astronomy, Case School of Applied Science. New York and London: McGraw-Hill Book Co. Inc. Cloth; 6x9 in.; pp. 225; illustrations, tables and line cuts. $3.

WATER POLLUTION RESEARCH BOARD (British Department of Scientific and Industrial Research): Report for 1930-31. Also: "Summary of Current Literature, January, 1932." Paper; 6x9 in.; pp. 39 and 36. 9d. for Report and 23d. for Summary from any H. M. Stationery Office.

Letters to the Editor

Pneumatic Placing of Tunnel Lining Saves Grouting

Sir—In your issue of Dec. 31, 1931, the article on tunnel grouting at Cobble Mountain contains the following paragraph, to which the writer takes exception:

> Grouting is always necessary behind concrete lining in a rock tunnel, *especially* if the concrete is placed by the pneumatic process. In setting, the concrete shrinks away from the rock surface, especially at the crown, leaving voids. Usually the depth of opening is greatest at the crown, narrowing toward the haunch and disappearing below the spring line.

This statement has been accepted at face value and has already been the cause of eliminating consideration of pneumatic placers on one tunnel and creating doubt as to its efficiency in several other cases. Tunnels lined by pneumatic placers require little or no grout as compared with tunnels lined by hand, conceding that there is no shrinking below the spring line.

Consider a typical arch form 60 ft. long to be filled by hand. The invert and sidewalls are concreted, it is assumed. The arch form has its plates fastened up to the haunch. Concrete is carried into the form, dumped on the working platform from cars and is shoveled over the top of the plates. When it reaches within a few inches of the top edge, the crown plates are fastened on the ribs.

At this time, orders are generally sent out to dry up the mix, as the laborers have to raise the concrete shoulder high to get it back of the crown plates. Up to the filling of the crown plates the concrete was placed over the side—that is, the laborer standing in the center is in a position to throw the concrete to either side—but with the key plate in place, the concrete must be pushed in the narrow opening banked by the previously placed concrete on either side, and as the aperture is directly overhead it is quite apparent that "soupy" concrete could not be rammed into this opening. Actually only the driest kind of a mix is pushed in and rammed as well as it is possible, leaving not only plenty of voids but a loose unsatisfactory key, bonded enough to give a good finish but requiring plenty of grout.

An examination of finished concrete at the bulkhead shows that concrete placed by the pneumatic process is dense and solid around the entire perimeter and well bonded into the surrounded rock, while that placed by hand will show spaces over the key and crown plates.

On short stretches of 10 to 20 ft. of concrete lining pneumatically placed for reinforcing purposes in tunnels, there is no visible shrinkage at the ends. An incident of interest occurred while concreting the Chicago sewers. A local contractor had placed about 100 ft. of concrete lining by hand and then set a pneumatic placer in the finished tunnel about 30 ft. from the end of the concrete. He then began placing concrete by air. At the end of an hour grout from the fresh concrete (being placed by the pneumatic method) was forced through the previously hand-placed concreted arch, back as far as the machine.

It does not follow, however, that tunnels lined by the pneumatic method do not require grouting. On the contrary, hundreds of barrels may be required at a single inlet, depending entirely on the nature of the rock, how it breaks and trims, and whether seams or fissures are encountered. The type of rock is by far more important than the concrete when considering how much grout will be placed behind the lining.

Tunnels properly lined by the pneumatic method will take far less grout than if lined by any other method, and the concrete will prove better in every respect.

JAMES H. FITZGERALD
Fitzgerald & Hudson

New York City,
Jan. 21, 1932.

Reconstruction Credit for Municipal Works

Sir—Permit me to express my cordial approval of the editorial entitled "Work Still to Be Done" in your issue of Jan. 28. The present deplorable situation of curtailed municipal construction work results less from a desire to economize or to defer desirable construction than from the sheer inability of the municipalities to market their securities. It seems to me that too much thought and energy are being expended on consideration of the stabilization of industry which, though a highly desirable end in itself, is one that may be deferred until the more immediate problem of the threatened bankruptcy of labor and industry has been solved.

One of the most urgent needs of the moment, as I view it, is such an expansion of the national credit structure as will make funds immediately available to municipalities for the prosecution of work now held up solely on account of their inability to dispose of their bonds in the present demoralized condition of the securities market. Excellent as is the recently enacted Reconstruction Finance Corporation Act, it is, in my judgment, not broad enough to meet fully the present emergent requirements. I believe that the act should be promptly amended to permit the corporation to purchase sound municipal securities covering work already authorized, and it should also authorize an additional bond issue of one billion dollars if and when that becomes necessary. Immediately upon the passage of such an amendment these sound municipal securities should be purchased in order that the sorely needed construction work may proceed without further delay. The present provisions of the act—all of them good—affect labor by secondary or reflex action only, whereas the proposed amendment provides direct action and the quickest way to create jobs for the unemployed.

In this connection I submit herewith copy of a report, dated Dec. 23, 1931, prepared by the Washington State Committee on Engineers and Employment, which deals with the problem of unemployment in this state and makes recommendations along the lines contemplated by the above proposed amendment. You will note the committee's estimate of

$10,000,000 for the state, and probably not less than $800,000,000 for the nation as a whole, of municipal work duly authorized and ready to go but now held up because of inability to find a market for the covering bonds. What could be more timely, more directly effective and more salutary for prompt relief of unemployment than to expand the federal credit provisions of the Reconstruction Finance Corporation Act so as to make possible the immediate commencement of this construction work?

Seattle, Wash., Feb. 11, 1932. JOSEPH JACOBS, Consulting Engineer.

The report, representing data supplied by 80 per cent of the cities and other governmental authorities in the state, showed the major items of ready-to-go work to be: $16,350,000 work awaiting funds available in 1932; $6,050,000 work held up by inability to sell bonds. These figures extended to the entire state would represent $17,800,000 and $8,900,000, respectively. For the whole country the committee estimated the total at $8,000,000 of local-improvement work held up by inability to sell bonds. It also found that there is no opportunity for increased employment by speeding up work already in progress; the only effective aid, therefore is found in starting the work now held up by the bond situation.

—EDITOR.

Regulating Interstate Truck Traffic

Sir—*Engineering News-Record* of Jan. 7, 1932, features an article by Thomas H. MacDonald, Chief, U. S. Bureau of Public Roads, entitled, "Urgent Problems Confront Public Roads Officials," Under the subtitle, "Restriction of interstate traffic," he deals briefly with the vexatious matter of taxation of motor-highway carriers — trucks and buses—operating across state lines.

Mr. McDonald recognizes the business barrier raised and the manifest unfairness to such carriers by taxation on the basis of full license charges paid to each and every state in which each carrier operates, yet he sees also the inequalities of compensation returns to the individual states for road use when such carriers operate under reciprocity agreements as usually understood and applied. He suggests that interstate carriers be set apart from private vehicles and taxed "upon the basis of the known capacity-mileage of the vehicles operated. . . . then each state in which they operate would receive its fair share of their tax payment." However, Mr. McDonald does not go into the application of the collection and distribution of such fees if charged on this basis.

It has for some time past seemed to me that this method of taxation is the practically correct one and that there is but one proper agency for the collection and distribution of fees by such a method. That agency, of course, is the national government. All motor-highway carriers, other than private passenger vehicles, that operate across state lines at any time should be deemed interstate carriers and registered and licensed as such by the national government, the display of whose license plates should exempt the vehicle from the purchase and display of the licenses of the states. Such fees collected by the national agency should be based on a sufficiently high yet not unreasonable rate, and the amounts collected, less expense of collection, should be returned to the states concerned.

As a basis for this return, licenses, scaled according to vehicle capacity, should be issued in three classes, the highest class being the most expensive, and successive classes being each slightly cheaper than the preceding one. A first-class license (most costly) should allow the vehicle a nation-wide scope of usage, second-class should cover any three (or it might possibly be four) continuously adjoining states named on the license plates, and third class any specified two adjoining states only. At the end of each month a sworn statement should be required for each vehicle so licensed, showing the number of miles covered by that license in each state operated in and returns to the states should be made one-fourth quarterly or one-half semi-annually on the proration of the individual annual license amount according to the miles of operation in each of the states for which the license is issued.

The truck or bus operating wholly within the confines of a single state would need only a license from that state and not be the concern of the national agency, but it would be subject to arrest by authorities of another state if found outside its own state with such a license; that is, there would need to be no reciprocity agreement that now cause so much trouble between the states, though these would not be prohibited if the states choose to make them. Vehicles bearing second- or third-class national licenses would also be subject to arrest if out of the states for which their license plates show them to belong.

It will be noted that the enforcement of this provision would not devolve on the national agency nor be any concern of theirs, but it would automatically fall to the same state and local agencies now engaged in preventing the use of improper licenses. Also weight, size and speed limitations, etc., would still be the concern of the various states, and vehicles would be subject to such regulations as were laid down by the state in which the vehicle operates.

Now, of course, a large part of our road funds are raised from gasoline taxes, and quite often this tax rate is not the same in adjoining states, causing a decided tendency for interstate trucks and buses to carry large tanks and fill them up in the states where the fuel tax is lower, buying no fuel in the higher tax states. Indiana, for instance, suffers quite an appreciable loss from this source, it is claimed, in the operation of carriers between Illinois and Michigan around the lower end of Lake Michigan. Just what can be done about this is, indeed, a question. Also, there is now being developed a seemingly practical diesel motor for trucks and buses that will use no gasoline at all and the operation of which will further complicate this angle of the situation. It might possibly be that the license fees charged should be figured on the basis of an estimated reasonable charge above a certain minimum gas tax of, say for example, 2c. per gallon, all gas taxes above this minimum to be refunded to the operator by the collecting state. For diesel motors an equivalent fuel charge might be computed as a basis for a similar taxation and refund on fuel oil.

This is a controversial subject and, of course, all will not agree with the above, but it will certainly have to be worked out in some better manner than now prevailing.

H. O. WIMSETT,
Locating Engineer,
Indiana State Highway Commission.
Indianapolis, Ind.,
Jan. 18, 1932.

Solar Meridian by Stopwatch

Sir—With reference to an article, "Solar Meridian by Stopwatch," by James Girand, Jr. (*ENR*, Sept. 10, 1931) and criticism of Oct. 22, p. 666, also Mr. Girand's reply of Dec. 10:

It is true that a maximum change in solar declination for the ordinary observation would not be more than 5 sec. of arc (.97 min. or 58 sec. of arc per hour for an observation lasting from 4 to 5 min.). This change, however, necessitates a correction in altitude and in bearing, in amount dependent upon the latitude of the observer and the hour of observation. The point that has been overlooked in the discussion is that the correction in altitude is made to the increment of altitude *dh*, while the correction in bearing is made to the total observed horizontal angle; the *percentage* corrections are of very different proportions.

In the original example the change of declination for the date given would be very nearly the maximum, the corresponding correction to the change of altitude being in the order of 2 to 3 sec. of arc. A correction of 1 sec. of arc in *dh* causes a change of approximately ½ min. in azimuth, 3 sec. of 1¾ min., and 5 sec. of 5¼ min. in azimuth or final bearing.

It is evident that in low latitudes that the correction will be less, being negligible for observations at the equator, but of sizeable proportions in high latitudes. Also, the correction is a maximum near mid-day and a minimum with the sun at the horizon. The direct correction to horizontal angle, as mentioned by Mr. Girand in his reply, is, as he says, so small as to be negligible at all times.

ARNOLD B. STAUBACH.
New York, N. Y.,
Jan. 18, 1932.

NEWS OF THE WEEK

Road Expansion and Aid Bill Defeated By Close Senate Vote

BY A vote of 48 to 35 the U. S. Senate on Feb. 16 rejected the LaFollette-Costigan bill, which carried an appropriation of $350,000,000 for direct aid to the unemployed and under the Norris amendment a like amount for road construction.

Before the vote on the main motion several amendments were voted down. That of Senator Couzens, setting up a relief fund of $375,000,000 to be dispensed under direction of the President, was lost, 76 to 70. Senator Walsh offered a proposition to confine the relief to $375,000,000 for roads. This was defeated, 58 to 28. Senator Thomas' amendment increasing the total appropriation to a billion dollars by adding $250,000,000 for public buildings was voted down, 67 to 16. On the day previous the bill making appropriation of $750,000,000 to be equally divided between road construction and loans to states was defeated in the Senate.

Now that the La Follette-Costigan direct-relief measure has been defeated Senator Oddie, of Nevada, chairman of the committee on post offices and post roads, expects to report in the near future a bill authorizing an emergency appropriation for roads as well as the regular federal-aid authorizations. The exact amount of the emergency fund has not been decided upon but probably will be $75,000,000. The sections of the bill dealing with the regular authorizations will carry $125,000,000 for federal aid; $12,500,000 for forest roads; $7,500,000 for roads in the national parks and $3,000,000 for roads through public lands.

New York Engineers Discuss Need for More Relief Funds

The need for more funds for the relief of unemployment in the New York metropolitan district was the subject of discussion at a mass meeting held in the auditorium of the Engineering Societies Building, New York, on Feb. 15. The meeting was held under the auspices of the Professional Engineers Committee on Unemployment, representing the four founder societies in the relief work. Work of the committee to date was outlined by J. P. H. Perry, executive chairman of the committee, John P. Hogan and William Heyman. Other speakers were Michael I. Pupin, William Barclay Parsons, Robert Ridgway and Ely C. Hutchinson.

Up to Feb. 15 the committee had raised in cash or pledges $84,000. Its own payroll and loan expenditures amount to $18,000 a month and the payroll of the men it has placed with local relief agencies and in temporary work amounts to $75,000 a month. The total outlay to date from all sources amounts to $223,000.

The committee has received applications for relief from 1,806 men and has placed 852, including 211 on its own payroll. At present the committee has 59 men classified as destitute for whom it has not found jobs and 390 others approaching destitution. The prospects are that 600 more engineers will be thrown out of work within the next month by cuts in municipal and other activities.

A special plea was made at the meeting for contributions from men not members of the societies represented on the committee. To date all funds have been contributed by members of the societies, although half the men placed are non-members.

$32,319,235 Contracts Reported to Relieve Unemployment

Contract awards for public and semi-public works amounting to $32,319,235 were reported to the public-works section of the President's Organization on Unemployment Relief during the week ended Feb. 6, it is announced by Fred C. Croxton, assistant director. This brings the total of awards reported since Jan. 1 to $111,759,724.

Building Wages Are Reduced 20 Per Cent In Portland, Ore.

DECISION by arbitration to establ 1932 wage scales in the building trad in Portland, Ore., at 80 per cent of 19 scales was reached Feb. 5, thereby rem ing the cloud of uncertainty existing the for the past month, paving the way f eradication of bootlegging constructi work that had been going on to som extent during the past year and general making for stabilization in the constructi industry in that territory. An arbitrati board of nine—three from the Buildin Construction Employers Association, thre from the Building Trades Council and three neutrals—had heard evidence on bot sides for a week. Employers sought a 2 per cent reduction, while labor had offered to accept 10 per cent. The compromis effected was made retroactive to Jan. 2.

(Continued on page 265)

Extensive Public Works Reorganization Recommended by President

REDUCTION of the 150 to 200 separate governmental units of the federal administration, with a saving of many million dollars annually, was recommended by President Hoover in a message to Congress on Feb. 17. The reorganization proposed would include eight new officials: a public-works administrator, a personnel administrator (to be chairman of the Civil Service Commission) and six assistant secretaries, for public health, education, merchant marine, conservation, agricultural research, and agricultural economics. The reclamation service would be deprived of its present construction functions and would be made a bureau to administer the completed projects, under its former name of Reclamation Service.

Principles of reorganization

Gradual rather than sudden change in the existing department and bureau organization is recommended. After saying that "the ten major executive departments and the major regulatory financial boards and commissions" should be retained, the President lays down three suggestions as to procedure:

"(*a*) Consolidation and grouping of the various executive and administrative activities according to their major purposes under single-headed responsibility, the Congress designating the title of the officer to be placed in immediate charge of such groups as are not now possible under existing organization.

"(*b*) Adoption of the general principle that executive and administrative functions should have single-headed responsibility and that advisory, regulatory and quasi-judicial functions should be performed by boards and commissions, thus permitting the transfer of certain regulatory functions from executive officials to existing boards or commissions and executive functions from boards and commissions to executive officials.

"(*c*) Authority under proper safeguards to be lodged in the President to effect these transfers and consolidations and authority to redistribute executive groups in the ten executive departments of the government or in the independent establishments, as the President may determine, by executive order, such executive order to lie before the Congress for 60 days during sessions thereof before becoming effective, but becoming effective at the end of such period unless the Congress shall request suspension of action."

Rivers remain with army

Both construction and operation of works are to be in the hands of the proposed public-works administration. The message outlines this office as partly a service agency to other departments and partly an administrative agency to operate works after construction. It adds: "Naval, military and some other highly specialized construction work should not be transferred to this agency. The supervision and construction of rivers and harbors work should be continued under direction of the army engineers, who should be delegated by the secretary of war to the service of the administrator of public works for this purpose."

Complete reversal of existing reclamation policy is proposed in the paragraph of the message dealing with the functions of the reclamation service. Development of storage is contemplated as its principal

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Building Wages Reduced in Portland, Ore.

(Continued from page 264)

when former wage agreements expired, and was accepted by both sides.

The decision opens the way for the drive for all kinds of construction work planned by the Civic Building Service Bureau, organized late last year by interested organizations and public-spirited citizens with S. M. Lister as manager. This bureau up to Feb. 5 had secured pledges for nearly $3,000,000 of projects to start in the next six months. It will now increase its efforts.

20 Per Cent Wage Cut Also in Chicago

Under an agreement arrived at Feb. 12 between the Chicago Building Trades Council and the Building Construction Employers Association the union workmen will accept a 20 per cent reduction in wages for one year, the new scale going into effect on March 1. It is estimated that it will affect 125,000 men but that it will result promptly in active revival of building operations. According to reports about $150,000,000 of proposed construction in the Chicago district was postponed in 1930 and 1931 on account of difficulty in financing and high cost of construction, while under present arrangements labor costs are 20 per cent and material costs 30 per cent lower than last year, so that conditions are favorable for new building construction.

Appointments Made Under New San Francisco Charter

Appointments under the new charter, which went into effect in San Francisco Jan. 8 (*ENR*, Jan. 14, p. 73), are being made gradually.

John J. Casey, for the past several years inspector in the city engineering department, has been appointed city engineer by W. H. Worden, director of public works. Under the new charter the city engineer is in charge of general city engineering, streets, boulevards and sewer work, and all the responsibility of the public utilities has been transferred to the Public Utilities Commission.

M. M. O'Shaughnessy, city engineer since 1912, has been transferred to the Public Utilities Commission as acting chief engineer. Mr. O'Shaughnessy is in charge of Hetch Hetchy construction, and as this work has been placed under the jurisdiction of the utilities commission it was necessary that he be transferred.

Clyde E. Healy, formerly assistant city engineer, is placed in charge of the garbage-disposal study and boulevard and traffic terminal plans of the city.

The advisory committee to the bureau of building inspection of the city and county of San Francisco will continue to act in its advisory capacity as in the past. Members of this committee are: Walter Huber, consulting engineer, San Francisco; A. H. Wilhem, contractor, San Francisco; and Frederick Meyer, architect, San Francisco.

Sanitary District Officials Convicted of Conspiracy

Following the testimony of more than 750 witnesses in the $6,500,000 conspiracy-graft case against certain trustees and other officials of the Sanitary District of Chicago, Timothy J. Crowe, former president; Frank J. Link, former trustee; John T. Miller, former assistant superintendent, permanent plant and structures department, and Martin Edelstein, former real estate agent, have been found guilty. Crowe and Link received sentences of one to five years in the penitentiary, Miller and Edelstein were fined and sentenced to six and three months in the county jail. Three other trustees were acquitted and two have died since the trial started two years ago. In addition to payroll padding it was disclosed that a million dollar cinder path had been constructed which the court stated could have been built for one-third of that sum. It was also brought out that payments on contracts had been made twice and that dummy corporations had been organized solely for the purpose of dealing with the district and that they made overcharges of from 90 to 700 per cent.

Form of Contract Approved for All-American Canal

The Imperial Irrigation District, in southern California, in a special election held Feb. 11, approved the form of contract for the construction of the All-American Canal which is to distribute to that area water to be impounded by Hoover Dam. The proposal carried by a majority of five to one. This is the final formality which clears the way for the execution of that phase of the Boulder Canyon project which is secondary only to the erection of the dam itself.

The All-American Canal, so-called because it will supersede the present canal which runs in part through Mexico, will cost $34,000,000 and will float a ship drawing 20 ft. of water.

Favorable reports by the California District Securities Commission and the state engineer were noted June 28, p. 144.

Colorado River Aqueduct Bond Issue Is Again Upheld

Judgment in favor of the Metropolitan Water District of Southern California was rendered by the superior court of Los Angeles County, Calif., Feb. 8, in action brought by a taxpayer seeking to invalidate the $220,000,000 bond issue voted by the district for construction of an aqueduct from the Colorado River.

The taxpayer sought to invalidate the bonds on the grounds that the voters had been misled by pre-election statements and contended that the amount voted would be insufficient to construct the aqueduct, that the water would not be fit to drink and that voters had been deceived by promises of immediate employment for several thousand men. Experts called as witnesses refuted these claims and they are not upheld by the court.

This is the second case in which the superior court has upheld the validity of the bond issue. In the first action a Long Beach taxpayer attacked the issue on the ground that the Metropolitan Water District act was unconstitutional. This first decision has been appealed to the state supreme court.

ARLINGTON MEMORIAL BRIDGE OPENED TO TRAFFIC

The monumental Potomac River bridge that connects Washington, D. C., at the Lincoln Memorial with the new Mount Vernon express highway in Virginia will be opened to traffic on Sunday, Feb. 21, preceding Washington's Birthday. In appearance the bridge consists of nine arch spans, with an additional small arch at either end that crosses over low-level driveways along the river. Actually the main bridge consists of a 216-ft. double-leaf bascule at the center flanked by four full-barrel concrete arches of 166- to 180-ft. span. The movable span is one of the largest and heaviest bascules yet built. The arches are faced with granite and the bascule with ornamental sheet-iron. A 60-ft. roadway and two 14-ft. sidewalks are provided. The cost of the bridge was $7,500,000.

Reinforced-Brick Masonry Tests Reported at Meeting

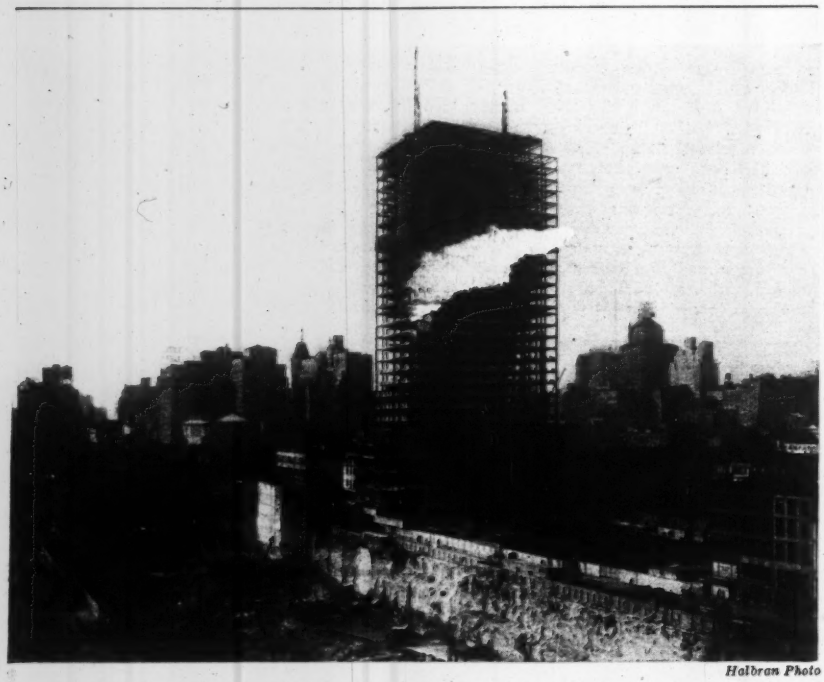
Favorable results recorded in tests of reinforced-brick masonry featured the joint session Feb. 11 of the National Brick Manufacturers Research Foundation and the Structural Clay Products Division of the American Ceramic Society in Washington.

Edward E. Krauss, the chairman, and Judson Vogdes, secretary of the committee on reinforced-brick masonry, alternated in presenting a series of seven reports on the design and specification of demonstration structures and the method and results of testing, coupled with the history of reinforced-brick masonry and a bibliography to date. A preliminary outline of future research and tentative specifications for reinforced-brick masonry also testify to the progress made by the committee during the past year.

Tests of thirteen demonstration structures consisting of two beams and a slab disclosed the uniform strength and stiffness of this construction, despite variations in workmanship and materials, and under loads far greater than those encountered in ordinary practice. The primary object of the tests was to reveal any deficiencies in performance with a view to formulating minimum standards. Failures attributed to the sand used in the 1:1:6 mortar recalled early experience in reinforced-concrete masonry; well-graded, clean, sharp sand, free from silt, is essential. Proper embedment of the reinforcing also is necessary. Tentative specifications covering the principal factors to be observed to obtain good work have been drafted to furnish engineers and architects with a guide for preparing specifications for their particular projects. Much laboratory work remains to be done in determining design data, as Mr. Krauss emphasized that no greater use of reinforced-brick masonry can be expected until practical design formulas are available to engineers and acceptable to building inspectors. With that end in view cooperative contacts have been established with engineering societies and an advisory committee has been organized that includes representation of the engineering faculties of a score of universities.

Construction of a reinforced-brick masonry cantilever arch bridge on the Brunel principle was described by Mr. Vogdes, the engineer. Problems met in construction of the water tower inclosure at Baltimore were explained by Mr. Benjamin, the engineer. Investigation by the U. S. Bureau of Standards on materials for reinforced brickwork was discussed by D. E. Parsons, chief of the masonry construction section. Following the session, the group witnessed a test of the demonstration structure at the plant of the West Brothers Brick Co.

Emerson P. Poste, of the Chattanooga Stamping & Enameling Co., was elected president and W. Keith McAfee, president of the Universal Sanitary Manufacturing Co., was elected vice-president of the American Ceramic Society. Other officers were reelected.



Halbran Photo

FIRST STEEL IN NEW YORK SKYSCRAPER GROUP TOPPED OUT

The initial change in New York City's skyline to be caused by the Metropolitan Square, or "Radio City," development occurred last week with the completion of the steelwork on the 31-story R-K-O office building on the northwest corner of the three-block site. Steel erection on a 3,500-seat vaudeville theater on the southwest corner of the site has begun. To the right of the R-K-O building may be seen the first framing of the 6,100-seat motion picture theater. In the foreground of the illustration the foundation excavation for the 68-story central skyscraper is approaching completion and column grillages are being set. This excavation is 535 ft. long, 200 ft. wide and involves about 175,000 cu.yd., of which 95 per cent is rock. The deepest part of the excavation is 65 ft. below the curb. On the R-K-O building may be seen some of the 7,200 cast aluminum spandrels that will be used on the first three office buildings now under contract.

Washington Notes

By Paul Wooton
Washington Correspondent

TWO bills have been reported out recently by the committee on irrigation and reclamation of the House of Representatives. One provides for loans for relief of irrigation districts, drainage districts and levee districts. The other proposes deferring all construction charges for 1931 and half of the construction charges for 1932 until the end of the contract period.

Many of the districts are not in a position to pay interest on their bonds. The purpose of the loans is to pay bond interest or, in certain cases, to retire the bond issue through compromise with the owners of the bonds. The bill carries an authorization for $100,000,000 to be used as a revolving fund, but it provides also that not to exceed $20,000,000 may be appropriated in any one year.

The prospects of these measures becoming law are not bright, but active efforts have been made to insure their passage in the House.

Hearings on Trade Practice Bills

Hearings on the Nye trade practice bill have been tentatively scheduled for Feb. 24-25 by the Senate judiciary committee. This will give trade association executives an opportunity to tell their story of the complications that have crippled the usefulness of the Federal Trade Commission's conference procedure for the elimination of unfair and uneconomic trade practices. The subject matter of the bills before the committee is not regarded as of immediate importance if eventually legislation can be drafted that will perfect the operation of the trade practice conference plan and possibly of the commission's functions as a whole. The conviction is growing in Washington that business sooner or later will find a method by which it will be able to obtain from the government competent advice upon the legality of proposed activities. It is becoming equally certain that this will not be accomplished by amending the anti-trust laws.

Topographical Survey Faces Smaller Appropriation

Appropriation for the Topographical Survey has been slashed by the House appropriations committee from the budget estimate of $616,000 to $366,000, plus an unexpended balance of $85,990 that will remain from the current year's appropriation of $780,000 if no further cooperative commitments are made by the states before June 30.

The item as reported by the House committee, besides cutting the total appropriation so drastically, also would cripple the Survey's work by limiting funds for state cooperation to $256,000. As $350,000 has already been pledged by the states, the Survey would suffer a double loss. Representative Temple, of Pennsylvania, asserted on the floor of the House Jan. 29 that unless sufficient appropriation is made annually, in accordance with the 1925 law, the topographical survey of the country will not be completed inside of 75 or 80 years, instead of 20 years as originally contemplated. Inquiry at the Geological Survey reveals that of its staff of 200

topographical engineers 58 are on furlough now. This number probably will be increased to 90 by July 1 and to 110 unless the appropriation carried in the bill as reported from committee is increased.

Delay Recapture Cases

The Interstate Commerce Commission has estimated that, even without litigation, it will be 1935 before its work on finally establishing the recapture liability of individual railroads is brought down to date. The railroads are in the position of having to defend, at great expense, cases that may never come to a verdict. This has given rise to the suggestion in railroad circles that the I.C.C. suspend prosecution of recapture claims until Congress votes on the unanimous demand for repeal of the law.

Public Works Reorganization

(Continued on page 264)

activity, this being declared to be "properly work of the federal government." Reclamation construction is to be carried out by the public-works administrator, the reclamation service becoming purely an operating body. The message says:

"With respect to certain agencies in the government, I recommend a separate legislative reorganization of policy. The first of these is the reclamation service. Reclamation should have a broader import than that of bringing unproductive land under cultivation. We do not need further additions to our agricultural land at present. Additional agricultural production except such marginal expansion as present projects warrant is inadvisable.

"The conservation of water by storage is required, not alone in the West but in all parts of the country.

"The effective development of water conservation through storage is largely an interstate question in the aid of domestic and industrial water supply, transportation, irrigation and flood control. Where construction work for storage relates to these larger issues, it is properly the work of the federal government. Where water power is developed as a byproduct, it should be disposed of in advance by contracts which will fairly reimburse the government for its outlay. The reclamation service should be extended to cover these broad purposes of storage and conservation of water rather than the narrow purpose of irrigation. . . . The actual construction work under this plan should be carried out by the public-works administrator and the completed projects administered by the reclamation service."

Banks Come to Assistance of Hetch Hetchy Project

SHUT-DOWN on construction operations of the Hetch Hetchy project has been averted by an offer of seven San Francisco banks to buy at once $500,000 of Hetch Hetchy bonds at par. This money will finance operations for at least five weeks. Stopping operations, which would have thrown about 1,500 men out of work, was feared when the city failed, because of present bond market conditions, in several attempts to dispose of the $4,000,000 of unsold bonds. One plan considered was to pay the workers with bonds to be discounted by banks, which would be a legal procedure for the city's disposal of bonds at par. The workers had agreed to this plan, but the offer of the banks renders it unnecessary. However, the Public Utilities Commission is negotiating with the companies supplying materials to accept bonds in payment.

Steps are being taken to place a bond issue before the voters at the presidential primary election on May 3 to finance the completion of the Hetch Hetchy system. The amount of the issue, which is expected to be near $5,000,000, will be determined when estimates of the work to be done are submitted by M. M. O'Shaughnessy, acting chief engineer of the Public Utilities Commission.

COSTS AND CONTRACTS

ENR Index Numbers

	Cost			Volume	
Feb.,	1932	161.82	Jan.,	1932	121
Jan.,	1932	162.48	Dec.,	1931	133
Feb.,	1931	196.61	Jan.,	1931	208
Average,	1931	181.35	Average,	1931	220
Average,	1930	202.85	Average,	1930	260
1913		100.00	1913		100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Feb. 18, with some comparisons, total as follows:

(In Thousands of Dollars)

	Feb. 18,	Average of Last Four Weeks	
Buildings:	1932	1932	1931
Industrial	$1,040	$1,926	$3,161
Other	7,985	9,032	16,505
Streets and roads	3,975	2,845	9,668
Other construction	6,590	5,485	15,830
Total	$19,590	$19,290	$45,165

Total, all classes, Jan. 1 to Feb. 18:
1932 ..... $145,456
1931 380,821

Hoover Dam Notes

The first serious flood on the Colorado River since the start of the Hoover Dam project reached Black Can[illegible] 10, necessitating shutting down the work for several days. Three of t[illegible] diversion tunnels were flooded. No extensive damage was reported outside of the washing away of a temporary truck bridge across the river, which was already being replaced by a substantial suspension span. Concrete protection walls will be built at the upper portals of the tunnels to protect them from similar rises of the river in the future.

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On Jan. 31 the 41x56-ft. headings in tunnel No. 3 were holed through, and those in tunnel No. 2 met three days later. Driving of the enlarged headings was stopped at the inlet end of tunnel No. 1 on Feb. 5 and at the outlet end of tunnel No. 4 on Feb. 1. On Feb. 6 there remained 1,875 ft. of enlarged heading to drive in tunnel No. 1 and but 286 ft. in tunnel No. 4. Removing the 15-ft. invert bench was started in tunnels No. 3 and No. 4 the first of the month. Invert cuts in both tunnels are carried back on an incline for 250 ft. before excavation is made for the full invert.

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Excavation for the foundations of the structures at the intake portals of tunnels No. 1 and No. 2 was started during the week ended Feb. 6 and carried down to the level of the invert of the diversion tunnels, ready to commence excavation of the rock in the lower portions of those tunnels.

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Drilling and blasting operations were continued in the Nevada spillway. In the inclined spillway tunnels 7x10-ft. pioneer bores have been completed for 186 ft. in the Nevada tunnel and 82 ft. in the Arizona tunnel. The measurements are taken from the top of the diversion tunnels.

• • •

More than 4,000 persons are now employed on the project and in Boulder City. During January 7,335 visitors were admitted to the reservation. A discovery of gold on the Arizona side of the Colorado River 4 miles east of the dam site is attracting local attention.

• • •

The first purchase of lands condemned for the reservoir back of the dam was made during the week, when $1,000 was paid for 80 acres near the mouth of Muddy River a mile from St. Thomas.

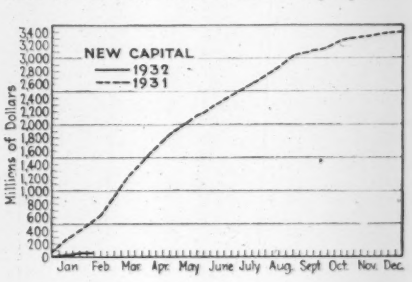
• • •

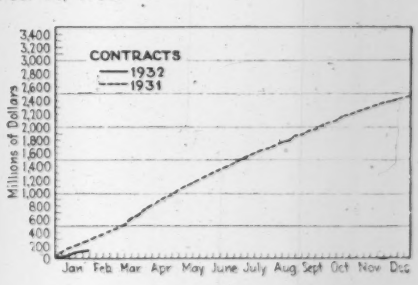
At Boulder City the filtration plant is [illegible] per cent complete. The sewage-disposal plant lacks only 10 per cent of being complete. A trial operation of the plant is expected in the near future.

Capital and Contracts

New capital issued during the week ended Feb. 13 consisted of $2,000,000 in public bonds. Not since the last week in January has any private capital been issued. Moreover, there were no flotations of any kind in the first week of February. January financing totaled $52,000,000 compared with $324,000,000 last year.

The cumulative total for this year is $54,000,000, compared with $470,000,000 issued in the period between Jan. 1 and Feb. 14, 1931.





Personal Notes

C. H. BIRDSEYE, former chief topographic engineer of the Geological Survey and more recently the president of the Aerotopograph Corporation of America, has returned to the Survey to become engineering assistant to W. C. Mendenhall, director.

SAMUEL O. LINSELL, assistant chief engineer of highways in the tenth district of Ohio, with headquarters at Marietta, has been named assistant engineer in charge of the bureau of maintenance in the central offices in Columbus.

EDWARD M. ELLIS, of Rye, N. Y., formerly engineer with the department of public works, Albany, N. Y., has accepted a position with North Jersey Amusements, Inc., as engineer and manager.

T. B. WARDEN has been named district engineer for the Portland Cement Association in the Dallas, Tex., district.

CHARLES H. PIERCE, formerly with Charles T. Main, Inc., of Boston, is now hydraulic engineer with the water resources branch of the U. S. Geological Survey, Washington, D. C.

RUSSELL V. BLACK, of Philadelphia, has been selected to serve as consulting expert to the city plan commission of Englewood, N. J. HENRY M. BRINCKERHOFF, of the firm of Parsons, Klapp, Brinckerhoff & Douglas, and ARTHUR E. BREMER have been appointed members of the city plan commission.

Obituary

SVERRE DAHM, consulting engineer for the New York City board of transportation and formerly chief designer for the board, died on Feb. 14 at the age of 73. Mr. Dahm was born in Norway and studied engineering at the University of Norway. He went to Panama with De Lesseps in the first attempt to build the Panama Canal and when that venture failed he came to the United States. In 1900 he was appointed an assistant engineer engaged in designing the stations on the first subway, in the employ of the New York Rapid Transit Construction Railroad Commission. In 1905 he was made chief engineer of design, a position he held until three years ago, when, at the age limit of 70 years, he was retired. He was retained, however, as consulting engineer.

ROBERT COREY SIMONS, for the last fifteen years in private practice in Salt Lake City, died on Feb. 6, aged 73. A native of Providence, R. I., Mr. Si went to Utah many years ago and at time was in the city engineer's offic Salt Lake City. He also had been the Utah Copper Co. and the Oregon S Line and was assistant engineer in De for the Denver, Rio Grande & We R.R.

ROBERT G. SCOTT, president of S Brothers Construction Co., of Rome, N died on Feb. 7, aged 64. This is the t loss by death recently for the conc which was composed of four broth On Sept. 6 William E. Scott, treasu died and James P. Scott, vice-presid died on Oct. 29.

FRANK A. GAGEBY, 68 years old, the last ten years field engineer for Indiana highway commission, died recen in an Indianapolis hospital after an illn of several weeks.

JOHN H. HAMILTON died at his ho in Amherst, N. S., recently at the age 79. During an engineering career of years Mr. Hamilton was affiliated wi some of the most important engineeri works in the maritime provinces, inclu ing the building of new branch lines and the transcontinental division of the Can dian National Railways. He also serve as an engineer in the provinces of Man toba, Saskatchewan and Alberta.

SOCIETY CALENDAR

AMERICAN CONCRETE INSTITUTE, annual convention, Washington, D. C., March 1-4.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, annual convention, Chicago, March 15-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, June 20-24.

AMERICAN WATER WORKS ASSOCIATION, annual convention, Memphis, Tenn., May 2-6.

CONCRETE REINFORCING STEEL INSTITUTE eighth annual meeting, March 7-9, Atlanta, Ga.

AMERICAN WATER WORKS ASSOCIATION will hold its 52d annual convention in Memphis, Tenn., during the week of May 2. The nominating committee has reported the following ticket: president, George W. Pracy, superintendent, water department, San Francisco, Calif.; treasurer, William W. Brush, chief engineer, department of water supply gas and electricity, New York City. If no independent nominations are filed, the nominees will be considered elected.

ASSOCIATED GENERAL CONTRACTORS OF MISSOURI at a recent meeting in St. Louis elected as president George F. Maitland, vice-president of the Kansas City Bridge Co. Other officers elected are: highway vice-president, C. L. Harrison, Cape Giradeau; railroad vice-president, J. L. Allhands, Joplin; river vice-president, H. J. Massman, Kansas City; treasurer, Luke W. O'Brien, Kansas City.

ASSOCIATION OF PROFESSIONAL ENGINEERS for the Province of New Brunswick held its annual meeting at St. John on Jan. 25, and elected A. R. Crookshank, of St. John, president. G. C. Torrens, of Moncton, was elected vice-president. C. H. Wright, of Halifax, formerly engaged in engineering in Manitoba and Ontario, spoke on "Engineering Developments in Northern Manitoba," and questioned the wisdom of constructing the proposed Hudson Bay Railroad.

INDIANA ENGINEERING SOCIETY will hold its 52d annual meeting and engineers' conference at Purdue University, Lafayette, Feb. 25-26.

CHATTANOOGA SECTION, American Society of Civil Engineers, newly chartered, holds its first meeting on the evening of Feb. 18. Officers of the section are: president, W. H. Sears; vice-presidents, O. J. Miller and J. A. Fairleigh; secretary-treasurer, W. R. King.

KENTUCKY ASSOCIATION OF HIGHWAY CONTRACTORS at its eleventh annual convention in Louisville elected J. M. Perkins, Frankfort, president; Emil Berry, Louisville, and Roy Gorrell, Russellville, vice-presidents; and D. C. Brooks, Frankfort, executive secretary.

MEMPHIS ENGINEERS' CLUB has elected the following officers: president, A. D. McWhorter; vice-president, H. M. Clayton; secretary-treasurer, J. J. Ryan.

MINNESOTA SURVEYORS AND ENGINEERS SOCIETY will hold its 37th annual convention in Minneapolis Feb. 25-26.

NATIONAL PAVING BRICK ASSOCIATION, meeting Feb. 10-12 in Chicago, reelected its officers. They are as follows: O. W. Renkert, president; W. H. Moseley, vice-president; S. Nirdlinger, treasurer; George F. Schlesinger, chief engineer and managing director; Q. A. Campbell, assistant chief engineer.

NEW ENGLAND SEWAGE WORKS ASSOCIATION will hold its annual meeting in Boston, April 25.

NEW YORK STATE HIGHWAY CHAPTER, Associated General Contractors of America, will hold its fifth annual convention in Utica, March 9-10.

NORTHWEST BRANCH, Associated General Contractors of America, has elected James Murdock, Seattle, president for the fourth consecutive term. James Warrack, Seattle, has been elected treasurer, P. L. Crooks, Portland, secretary, and H. V. Bogert, Seattle, recording secretary.

OREGON TECHNICAL COUNCIL, consisting of representatives of all major branches of engineering in the state, has elected P. R. Hines, mining engineer, Portland, Ore., president, and G. F. McDougal, mechanical engineer, vice-president. Directors elected are E. C. Willard, civil engineer, and C. H. Wallwork, architect. The chief function of the council during 1932 will be to direct the engineers' relief organization recently formed (*ENR*, Dec. 31, 1931, p. 1050). The retiring president of the council, O. L. LeFever, superintendent, Northwestern Electric Co., will continue as active head of the executive committee of this organization until the plan is in operation, and G. B. Herington, consulting engineer, will act as secretary. At present a survey of conditions respecting unemployment among engineers and a solicitation for funds in the different groups are going forward.

OHIO ENGINEERING SOCIETY has elected officers as follows: president, L. T. Fawcett, Youngstown; vice-presidents, Fred E. Swineford, Columbus, and Charles M. Gordon, Georgetown; secretary-treasurer, John Laylin, Columbus.

PORTLAND (ORE.) SECTION, American Society of Civil Engineers, has elected John W. Cunningham president, C. F. Thomas vice-president, G. H. Canfield secretary and Geary Kimbrell treasurer.

SEATTLE SECTION, American Society of Civil Engineers, has elected the following officers: president, O. A. Piper; vice-president, M. O. Syliassen; secretary-treasurer, Thomas D. Hunt.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION will hold its annual meeting at Oregon State College, Corvallis, Ore., June 29-July 1.

WASHINGTON (D. C.) CHAPTER, American Society of Civil Engineers, has elected the following officers: president, C. S. Birdseye; vice-president, H. S. McCrory; secretary-treasurer, F. W. Amadon.

WEST COAST LUMBERMEN'S ASSOCIATION, at its annual convention in Tacoma Jan. 29-30, did not fill the office of president, and J. D. Tennant, of Longview, will remain in office temporarily. Other officers elected were: vice-presidents, for Washington, Everett R. Griggs, Tacoma; for Oregon, M. C. Woodward, Silverton, Ore.; treasurer, R. W. Vinnedge, North Bend.

WYOMING ENGINEERING SOCIETY held its 30th annual meeting in Cheyenne Jan. 30, with nearly 100 in attendance. Officers elected are: president, Herbert L. Kennedy, Casper; vice-president, E. C. Gwillim, Sheridan; secretary-treasurer, Henry Lloyd, Cheyenne (reelected).

Construction Equipment and Materials

Machine Saturates Aggregates With Bitumen

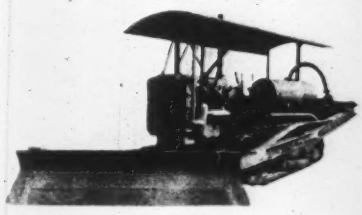
The Saturmix Corp., Wooster, Ohio, has developed a machine for saturating aggregates with bitumen. The process consists of supplying the aggregate to an immersion tank containing asphalt emulsion. In the tank is suspended a perforated basket so arranged as to be removed slowly, permitting drainage of the excess binding material. The plant can be equipped with

Machine for coating aggregates with bitumen.

axles and wheels to provide a portable unit, if desired. Bitumen is placed in the emulsion tank by an impeller pump. Aggregates can be charged by a clamshell bucket if desired.

Roadbuilder for Pioneer Work

Extreme ruggedness characterizes a road-grading unit designed by the LaPlant-Choate Mfg. Co., Inc., Cedar Rapids, Iowa, for use in building trails, roads, fire breaks and wagon trails in rock, clay and decomposed granite such as is found in mountainous regions. The carbon steel moldboard is $\frac{5}{16}$ in. thick, backed up by several steel castings, with a heavy $\frac{3}{4}$-in. plate reinforcement at the rear of the blade. The double edge reversible cutting edge is $\frac{3}{4}$x8 in. Heat-treated alloy cast-steel points at each end act as side cutting edges and also prevent the blade from digging too deeply. Attachment to the tractor is through a main frame which completely surrounds it. Rub rollers at the front of the frame on each side contact a plate on the back of the blade, permitting it to oscillate up and down. The blade edge is held in any position desired by means of locks, and may be set at an angle or parallel to the roadbed. A lock pin at the center of the plate permits it to be



Roadbuilding unit for mountain roads.

locked at a 90-deg. angle to serve as a bulldozer. As the weight of the road-building unit rests on a center pivot point, the tendency of the tractor to rise up in front is decreased. Raising and lowering the blade is controlled through a hydraulic jack placed in a horizontal position in the rear crosstie bar of the main frame.

The roadbuilder is designed for attachment to the Caterpillar 30 tractor, either standard or hillside models.

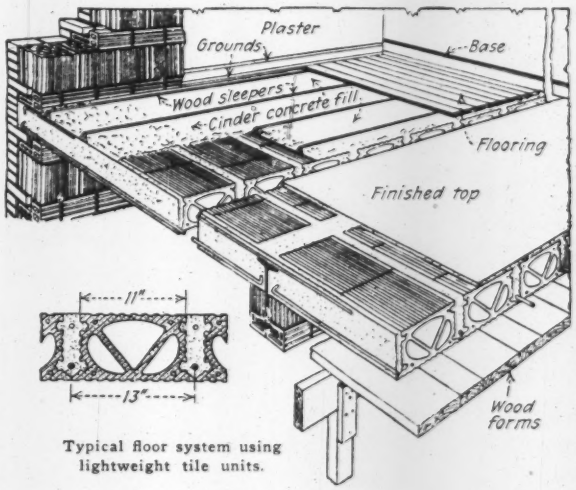
New Publications

Small Motors—Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo., has issued a new 30-p. booklet describing a line of single-phase, polyphase and direct-current motors in fractional-horsepower ratings. The bulletin, known as No. 167, is in looseleaf form, and five of the ultimate eight sections of the book are now available.

Reinforced-Concrete Roofs and Domes—A German patented system of construction which has been used extensively for roofs of dock sheds, garages, hangars, public halls and similar structures is described in a 24-p. pamphlet (Bulletin 138) issued by the Roberts & Schaefer Co., Chicago, which company has acquired the American rights for this system. Theory of design, tests and descriptions of structures are all included in the bulletin.

Road Machinery—Various forms of road graders for construction and maintenance work, as used in connection with tractor haulage, are included in a 32-p. pamphlet of the Caterpillar Tractor Co., Peoria, Ill.

Rail Crane—The No. 5 Parsons rail crane for handling rails and ties, or equipped with a $\frac{1}{2}$-yd. grab bucket for excavating, is described in an 8-p. pamphlet of the National Equipment Corp. (Parsons division), Newton, Iowa.



Typical floor system using lightweight tile units.

Business Notes

SHELL EASTERN PETROLEUM PRODUCTS, INC., has taken over Colas Roads, Inc., for the distribution of Colas road material, under licensing arrangements. J. S. Sawyer, formerly general manager of Colas Roads, will be in charge of the asphalt division, handling the Eastern states, with headquarters at 122 East 42d St., New York. The Shell Petroleum Corp., Shell Bldg., St. Louis, will be distributor for the Middle West, with David Waxman in charge. In the Far West the Shell Oil Co., Shell Bldg., San Francisco, will be distributor of Colas, continuing an arrangement in force two years. This division will also handle western Canada through its subsidiary, the Shell Oil Company of British Columbia, Ltd. The remainder of Canada will be covered by Colas Roads, Ltd., Daily Star Bldg., Toronto, and at Montreal. In Mexico Colas is distributed by the Compania Mexicana el Auila, S. A., of Mexico City, under the direction of Allen Payne.

WORTHINGTON PUMP AND MACHINERY CORP., Harrison, N. J., announces the following changes in personnel: C. E. Wilson, from general sales manager to vice-president in charge of industrial relations; Clarance E. Searle, formerly of Allis-Chalmers Mfg. Co., has been made vice-president in charge of sales; Charles N. Barney, former secretary and general counsel, is now secretary, treasurer and general counsel.

MEDUSA PORTLAND CEMENT CO., Engineers Bldg., Cleveland, Ohio, has taken over the entire distribution of rustproof coatings sold under the trade name of "Rust-oy," manufactured by the Studebaker Chemical Co., Elyria, Ohio.

CATERPILLAR TRACTOR CO., Peoria, Ill., has appointed C. E. McMullen, formerly of Madison, Wis., manager of engine sales in the special sales division.

ALLIS-CHALMERS MANUFACTURING CO., Milwaukee, announces the appointment of L. W. Grothaus as general representative to succeed C. E. Searle.

AMES - BALDWIN - WYOMING SHOVEL CO. announces the removal of its general offices from North Easton, Mass., to Parkersburg, W. Va.

Special Tile for Floors

Perfection of a special form of structural clay tile by the National Fireproofing Co., Pittsburgh, Pa., has led to the introduction of the Natcoflor System of constructing a light, strong, fireproof floor with a minimum of labor cost. Tiles are available in thicknesses of from 4 to 12 in. and are so designed as to place the maximum sectional area of the unit where it will be of the most use in resisting compressive stresses. Special clays are used to give high compressive strength.

The completed floor is a combination of the specially shaped tile with 2-in. cement joists or ribs laid 13 in. center to center between the tile units. Each rib is reinforced with two steel bars, one straight and one bent. Indentations on the exterior of the tile unit give thorough binding with the concrete. No concrete need be laid on top of the tile for structural purposes; wood sleepers can be placed directly and can be held in place with cinder fill or with sleeper clips.

The tile units are so formed that the bottom flanges are in closest contact, forming a pocket for casting the concrete joist and giving a continuous tile base for the ceiling below.

Current Construction Unit Prices

Filled-Arch Concrete Bridge

NEW YORK state department of public works, Albany, let the contract in January, 1932, for a filled-arch concrete bridge between Cohoes and Waterford, N. Y. The bridge has seven spans, is 54 ft. wide by 700 ft. long and is symmetrical. The center or river span is 96 ft. between pier faces; the three spans from shore to center span are respectively 82½ ft., 88½ ft. and 93 ft.

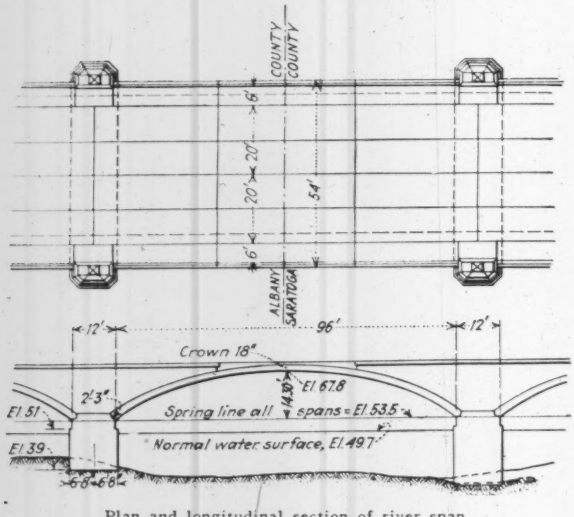
Depth of river is 12 to 13 ft.; clearance between normal water surface and bottom of arch, 18 ft.

Concrete items are: structures, 4,230 cu.yd. 1:2:3½; balustrade, 190 cu.yd. 1:1½:3; piers below El. 51, 2,720 cu.yd. 1:2½:5.

Traffic over existing bridge must be maintained until the piers and skewback of the south abutment have been completed, and the arch rings therefore cannot be constructed before this point is reached. Traffic will not be maintained during construction of the arch rings and north abutment.

Unit prices are given of the lowest three bidders: (A) Bates & Rogers, New York, contract; (B) A. Phelps & Sons, Detroit; (C) Lowensohn Construction Co., Cleveland. T. F. Farrell is chief engineer, division of engineering, state department of public works.

	A	B	C
Unclassified excavation, 4,200 cu.yd.	$1.95	$1.50	$1.65
Embankment in place, 310 cu.yd.	.70	1.00	.65
Pipe underdrain, 4 in. dia., 1,630 lin.ft.	.20	.20	.26
Trimming shoulders, 490 l.f.rd.	.10	.10	.10
Preparing fine grade, 5,230 sq.yd.	.08	.10	.10
Reinforced-concrete pipe, 12-in. dia., 260 lin.ft.	.95	1.25	1.20
Portland cement, 15,300 bbl.	1.63	1.90	2.00
Concrete for structures (1:2:3½), 4,230 cu.yd.	12.80	11.00	14.30
Concrete for balustrades (1:2½:3), 190 cu.yd.	35.00	38.00	32.00
Second-class concrete (1:2½:5), 2,720 cu.yd.	8.00	9.00	5.00
Stone masonry, 80 cu.yd.	23.50	25.00	23.00
Metal reinf. for conc. pav't., 5,820 sq.yd. pvt.	.20	.30	.26
Bar reinforcement for conc. pav't., 1,420 lb.	.07	.08	.08
Bar reinforcement for structures, 571,000 lb.	.04	3.32	.033
Miscellaneous iron and steel, 13,700 lb.	.15	.15	.15
Cement concrete pav't (1:1½:3), 1,570 cu.yd.	5.75	6.20	5.30
Membrane waterproofing with prot. co., 4,600 sq.yd.	1.45	1.50	1.70
Membrane waterproofing without prot. co., 1,180 sq.yd.	.60	1.00	.95
Protection of traffic (lump sum)	550.00	500.00	130.00
Removing exist. bridge superstruct. (lump sum)	2,950.00	3,000.00	3,000.00
Cofferdams, pump'g, bail'g and draining, (lump sum)	10,000.00	24,000.00	20,000.00
Timber sheetpiling, 6M. ft. b.m.	40.00	80.00	66.00
Granite curbing, 2,540 lin.ft.	1.50	2.00	2.00
Concrete gutters, 90 sq.yd.	1.45	1.50	1.30
Catch basins, 8	40.00	50.00	50.00
Conc. right-of-way markers, 16	2.00	2.50	2.50
Conc. sidewalk (two-course), 370 sq.yd.	1.50	1.25	1.00
Removing existing piers (lump sum)	3,300.00	3,000.00	2,800.00
Selected fill, 7,070 cu.yd.	.85	1.00	1.65
Ornamental lantern units, 20	70.00	75.00	65.00
2-in. fiber duct., 1,800 lin.ft.	.20	.20	.20
2½-in. fiber duct., 250 lin.ft.	.28	26.00	.25
Totals	$191,112	$203,911	$206,686



Plan and longitudinal section of river span of Cohoes-Waterford bridge.

Highway Bridge and Grade-Crossing Elimination

A NEW truss bridge with vertical lift span is replacing the old swing bridge over the Hudson River between Albany and Rensselaer, N. Y., with accompanying grade elimination, both highway and railroad, amounting to 36 per cent of the total cost of the project. Contract was let by the state department of public works in November, 1931, to Booth & Flinn, Pittsburgh, for $2,490,023. There were thirteen bids averaging $2,802,800, or 74 per cent of the engineers' estimate.

The bridgework involves (1) removal of the existing bridge; (2) construction of the new bridge; (3) building the Rensselaer approach, including highway grade-separation structure. The Albany approach requires elimination of crossings at grade of the Delaware & Hudson R.R. and at eight streets.

The bridge consists of four through-truss spans, west to east of following lengths c. to c. of end bearings: 222 ft., 341, 222 and 167 ft. The 341-ft. span is the vertical lift (clearance closed 35½ ft., open 135 ft.), and the 222-ft. spans carry towers supporting the lift span and counterweights. On the spans are two lines of trusses 47 ft. apart, with a 42-ft. roadway between and two 6-ft. concrete sidewalks outside the trusses. The roadway deck is a reinforced-concrete slab with bituminous surface and granite curbs. Truss spans for the river bridge were designed by Waddell & Hardesty, N. Y.

Principal items of both sections of the total project are cement, concrete, reinforcement and structural steel, aggregating 77 per cent of total cost. The prices given in the table are those of the low bidder.

Prevailing wage rates in Albany and Rensselaer are as follows: carpenters, $1.37½; ironworkers, $1.57½; bricklayers and cement finishers, $1.75; small mixer operators, $1.37½; electricians, $1.25; laborers, $0.75 building, $0.50 road. At Troy, Cohoes and Waterford the rate for carpenters is $1.25; for bricklayers and cement finishers, $1.65; for laborers, $0.50 to $0.68½.

PRINCIPAL ITEMS OF ALBANY-RENSSELAER PROJECT

	River Bridge			Albany Approach		
	Quantity	Unit Price	Amount	Quantity	Unit Price	Amount
15D Cement	40,000 bbl.	$1.40	$56,000	75,600 bbl.	$1.40	$105,840
Concrete	Cu.Yd.			Cu.Yd.		
16 Structures 1 : 2 : 3½	5,240	11.50	60,260	10,500	9.75	102,375
16A Roadway and walks 1 : 2 : 3½	1,350	14.50	19,575	.....	.....	.....
19 Balustrades 1 : 1½ : 3	252	32.00	8,064	760	32.00	24,320
20 1st class 1 : 2 : 4	4,960	6.00	29,760	760	9.50	6,840
21 2d class 1 : 2½ : 5	2,060	7.50	15,450	22,600	6.75	152,550
46 Pave.found. 1 : 2½ : 5	1,880	4.75	8,930	4,500	4.85	21,825
51 Pavement 1 : 1½ : 3½	320	5.50	1,760	4,900	5.50	26,950
125 Pier 1	5,050	46.00	232,300	.....	.....	.....
126 Pier 2	1,880	39.00	73,320	.....	.....	.....
127 Pier 3	1,020	39.00	39,780	.....	.....	.....
Total concrete	24,012		489,199	44,020		334,860
Per cent total section cost			31			38
Reinforcement	Lb.			Lb.		
26 Bars for structures	839,000	0.03	25,170	2,600,000	0.03	78,000
28A reinforcing trusses for slabs	136,009	0.04	5,440	.....	.....	.....
Total reinforcing	975,009		30,510	2,600,000		78,000
Per cent total section cost			1.9			8.8
Structural Steel:						
29A carbon	254,000	0.04	10,160	732,000	0.04	29,280
29B carbon	6,170,000	0.055	339,350	.....	.....	.....
29S silicon	2,400,000	0.06	144,000	.....	.....	.....
Total structurals	8,824,000		493,510	732,000		29,280
Per cent total section cost			31			3.3
Total sixteen items			1,069,319			547,980
Total contract price			1,601,392			888,632